DEPARTMENT OF THE INTERIOR,

CENSUS OFFICE.

FRANCIS A. WALKER, Superintendent,
Appointed April 1, 1879; resigned November 3, 1881.

CHAS. W. SEATON, Superintendent,
Appointed November 4, 1881.

REPORT

ON

COTTON PRODUCTION IN THE UNITED STATES;

ALSO EMBRACING

AGRICULTURAL AND PHYSICO-GEOGRAPHICAL DESCRIPTIONS

OF THE

SEVERAL COTTON STATES AND OF CALIFORNIA.

EUGENE W. HILGARD, Ph. D.,

Professor of Agriculture, University of California, former Professor at the University of Mississippi, and State Geologist,

SPECIAL AGENT IN CHARGE.

PART II.

EASTERN GULF, ATLANTIC, AND PACIFIC STATES.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1884.

SUBJECTS OF THIS REPORT.

PART I.

COTTON PRODUCTION IN THE MISSISSIPPI VALLEY AND SOUTHWESTERN STATES.

PART II.

COTTON PRODUCTION IN THE EASTERN GULF, ATLANTIC, AND PACIFIC STATES.

APPENDIX.

2403

REPORT

ON THE

COTTON PRODUCTION OF THE STATE OF ALABAMA,

WITH A DISCUSSION OF

THE GENERAL AGRICULTURAL FEATURES OF THE STATE.

BY

EUGENE ALLEN SMITH, PH. D.,
STATE GEOLOGIST AND PROFESSOR OF CHEMISTRY AND GEOLOGY AT THE UNIVERSITY OF ALABAMA,
AND
SPECIAL CENSUS AGENT.

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PART III.

MAPS AND ILLUSTRATIONS.

LETTERS OF TRANSMITTAL.

BERKELEY, CALIFORNIA, *September* 12, 1882.

To the SUPERINTENDENT OF CENSUS.

DEAR SIR: I transmit herewith a report on the cotton production and agricultural features of the state of Alabama, by Dr. Eugene Allen Smith, professor of chemistry and geology at the University of Alabama, and state geologist. In so doing, permit me to say that I consider Dr. Smith's report to be one of the best digested and most complete of the series of which it forms a part. The geology of Alabama is by far the most complex among the cotton-growing states, its formations ranging from the very base of the stratified rocks to the most modern, with a very varied representation of each of the several ages. This variety has in a great measure impressed itself upon the surface features and soils of the state, the consequence being that it is hardly possible to discuss the latter intelligently without frequent reference to the geological features. Hence the prominence necessarily given to the latter in the descriptions of the several regions.

The painstaking thoroughness of Dr. Smith's work will need no comment with the readers of this as well as other reports issued from his pen; but the amount of labor involved therein can hardly be appreciated save by those familiar with such work and with the extreme complexity of the natural features of the state.

Very respectfully,

E. W. HILGARD,
Special Agent in charge of Cotton Production.

UNIVERSITY OF ALABAMA,
Tuscaloosa, Alabama, August 1, 1882.

Dr. EUGENE W. HILGARD,

Special Census Agent in charge of Cotton Production.

DEAR SIR: With this I transmit my report on the cotton production of the state of Alabama. In the arrangement of the subject-matter I have followed the plan adopted by yourself in the report already published on the cotton production of the state of Louisiana.

The principal sources of information used in the preparation of the present report have been:

The geological reports of Professor M. Tuomey, published in the years 1850 and 1858, respectively.

The reports of progress of the geological survey, made by myself, for the years 1874, 1875, 1876, 1877–'78, and 1879–'80.

Manuscript notes of several excursions made by me, under the auspices of the Census Office, for the purpose of collecting soil specimens and certain data for this report.

The answers returned by correspondents from the various counties to whom were sent the schedules of questions relating to cotton culture.

From *Dr. Charles Mohr*, of Mobile, a special agent of the Census Office, I have received many valuable notes on the botanical character of the different parts of the state.

The county officers in many parts of the state have given, upon solicitation, much information regarding their own sections.

More than half of the analyses of soils and subsoils given have been made at the expense of the state geological survey, and acknowledgments are due also to Messrs. McCalley, Cory, Durrett, and Langdon, students in the chemical laboratory of the University of Alabama (employed also by the Census Office and by the state survey), for analyses made by them without charge.

Finally, free use has been made of the published bulletins of the Census Office.

The details of the arrangement of the matter of this report are as follows:

The tabulated results of the enumeration relating to area, population, and cotton production, and to the production of the leading crops.

Part I. A general account of the physical and geological features of the state.

A special description of the agricultural subdivisions or regions, accompanied by analyses of the most characteristic soils and discussions of the analyses. The soils analyzed were collected by myself, except those otherwise specially credited.

Next follows a list of the botanical and common names of the characteristic timber trees and other plants of the several regions, including those giving most trouble to farmers, as weeds.

Part I concludes with some remarks on cotton culture in the state, in which the statistics are presented in tabular form, to show the relations of the several regions in respect of area, population, and cotton production, and to compare these regions, as regards their product per acre and their respective contributions, to the total production of the state. Under each region are also given the "banner" counties in regard to the product per acre and total production, and a general discussion of the areas of greatest production, of the relations between the population and cotton production, the part borne by the two races (black and white) in cotton production, with some inferences drawn concerning the effect on the soil and on the yield of the prevalent systems of farming. This is followed by a chapter on the use of fertilizers in cotton planting, and an account of the materials naturally occurring in Alabama, which have been, or which may hereafter be, used in the improvement of the soils.

Part II is devoted to the agricultural descriptions of the counties of the state, grouped under the several agricultural regions described in Part I. When a county belongs to more than one of these divisions, it is described in connection with that region with which it is thought to have most in common.

Each county description is preceded by a heading giving data relating to population, area, lands in cultivation, with the proportion devoted to each of the leading crops, but particularly to cotton, under which head are given the number of bales, the average product per acre, and the percentage of tilled land in cotton.

The statements of areas are based upon measurements which have been made as accurately as possible, but they are to be considered only as approximations, since the lines separating the several agricultural regions are themselves to a certain extent conventional.

In the county descriptions abstracts are given of the answers to the schedule questions relating to the soil varieties, their yield of seed-cotton when fresh, the most troublesome weeds, prevalent practice with regard to protection against injury from washes, etc.

The great discrepancy between the estimates of correspondents and the enumeration returns regarding the average yield of the soils is more particularly noticed in the section devoted to remarks on cotton culture.

Part III is devoted to the details relating to culture, system of farming, etc., being an abstract (condensed, but containing all the essential material) of the answers to the schedule questions relating to tillage and improvement of land, planting and cultivation of cotton, ginning, baling, and shipping of the same, diseases and insect enemies, etc., and to labor and system of farming.

Very respectfully,

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EUGENE A. SMITH.

TABULATED RESULTS OF THE ENUMERATION.

TABLE I.—AREA, POPULATION, TILLED LAND, AND COTTON PRODUCTION.

Counties.	Areas (square miles).	POPULATION.						TILLED LAND.		COTTON PRODUCTION.								
		Total.	Male.	Female.	White.	Color'd.	Per square mile.	Acres.	Percentage of area.	Percentage of tilled lands in cotton.	Acres.	Bales.	Average per acre.			Cotton acreage per square mile.	Bales per square mile.
													Bale.	Seed-cotton.	Lint.		
The State	51,540	1,262,505	622,629	639,876	662,185	600,320	24	6,134,198	19	38	2,330,086	699,654	0.30	429	143	45	14
METAMORPHIC REGION.																	
Cleburne	540	10,976	5,356	5,620	10,308	668	20	51,428	15	18	9,156	3,600	0.39	555	185	17	7
Randolph	610	16,575	8,198	8,377	13,155	3,420	27	81,426	21	28	23,177	7,475	0.32	456	152	38	12
Chambers	610	23,440	11,517	11,923	11,364	12,076	38	149,283	38	48	70,934	19,476	0.27	384	128	116	32
Lee	610	27,262	13,079	14,183	12,217	15,045	45	122,875	31	42	51,889	13,189	0.25	357	119	85	22
Tallapoosa	810	23,401	11,578	11,823	16,108	7,293	29	143,175	28	29	41,200	14,161	0.34	486	162	51	17
Clay	610	12,938	6,330	6,608	11,870	1,068	21	57,972	15	24	13,921	4,973	0.36	513	171	23	8
Coosa	670	15,113	7,500	7,613	10,050	5,063	23	80,791	19	33	26,468	8,411	0.32	456	152	40	13
Total	4,460	129,705	63,558	66,147	85,072	44,633	29	686,950	24	34	236,745	71,285	0.30	429	143	53	16
COOSA VALLEY REGION.																	
Cherokee	660	19,108	9,679	9,429	16,418	2,690	29	88,819	21	27	24,388	10,777	0.44	627	209	37	16
Calhoun	640	19,591	9,836	9,755	14,134	5,457	31	93,857	23	28	26,435	10,848	0.41	585	195	41	17
Etowah	520	15,398	7,703	7,695	12,896	2,502	30	60,780	18	25	15,187	6,571	0.43	612	204	29	13
Saint Clair	630	14,462	7,231	7,231	11,621	2,841	23	65,105	16	23	14,735	6,028	0.41	585	195	23	10
Talladega	700	23,360	11,380	11,980	10,856	12,504	33	113,389	25	29	32,841	11,832	0.36	513	171	47	17
Shelby	780	17,236	8,664	8,572	12,253	4,983	22	58,550	12	31	17,919	6,643	0.37	528	176	23	9
Total	3,930	109,155	54,493	54,662	78,178	30,977	28	480,500	19	27	131,505	52,699	0.40	570	190	33	13
COAL-MEASURES REGION.																	
De Kalb	740	12,675	6,300	6,375	11,993	682	17	52,096	11	14	7,469	2,859	0.38	543	181	10	4
Marshall	560	14,585	7,208	7,377	13,084	1,501	26	68,175	19	24	16,412	5,358	0.33	471	157	29	10
Cullman	590	6,355	3,234	3,121	6,312	43	11	20,527	5	7	1,469	378	0.26	372	124	2	1
Blount	700	15,369	7,644	7,725	14,210	1,159	22	68,860	15	18	12,502	4,442	0.36	513	171	18	6
Jefferson	960	23,272	11,896	11,376	18,219	5,053	24	71,959	12	20	14,220	5,333	0.38	543	181	15	6
Walker	880	9,479	4,633	4,846	8,978	501	11	46,725	8	19	8,743	2,754	0.31	441	147	10	3
Winston	640	4,253	2,131	2,122	4,236	17	7	17,767	4	12	2,048	568	0.28	399	133	3	1
Total	5,070	85,988	43,046	42,942	77,032	8,956	17	346,109	11	18	62,863	21,692	0.35	498	166	12	4
TENNESSEE VALLEY REGION.																	
Jackson	990	25,114	12,626	12,488	21,074	4,040	25	123,924	20	16	19,685	6,235	0.32	456	152	20	6
Morgan	700	16,428	8,185	8,243	11,758	4,670	23	95,584	21	20	18,828	6,133	0.33	471	157	27	9
Madison	810	37,625	18,538	19,087	18,591	19,034	46	219,221	41	34	72,838	29,679	0.28	399	133	90	36
Limestone	590	21,600	10,762	10,838	11,637	9,963	37	129,477	34	34	44,334	15,724	0.35	498	163	75	27
Lauderdale	700	21,035	10,485	10,550	14,173	6,862	30	102,839	23	26	26,594	9,270	0.35	498	166	38	13
Lawrence	790	21,392	10,620	10,772	12,642	8,750	27	138,034	27	31	42,803	13,791	0.32	456	152	54	17
Colbert	570	16,153	7,980	8,173	9,203	6,950	28	74,876	21	34	25,411	9,012	0.35	498	166	45	16
Franklin	610	9,155	4,523	4,632	8,079	1,076	15	46,895	12	22	10,368	3,603	0.35	498	166	17	6
Total	5,760	168,502	83,719	84,783	107,157	61,345	29	924,850	25	28	260,861	84,447	0.32	456	152	45	15
OAK AND HICKORY UPLANDS, WITH SHORT-LEAF PINE.																	
Marion	810	9,364	4,599	4,765	8,841	523	12	42,925	8	17	7,260	2,240	0.31	441	147	9	3
Lamar	590	12,142	5,992	6,150	9,967	2,175	21	62,141	16	25	15,245	5,015	0.33	471	157	26	8
Fayette	660	10,135	5,061	5,074	8,873	1,262	15	56,118	13	22	12,331	4,268	0.35	498	166	19	6
Pickens	1,000	21,479	10,605	10,874	9,132	12,347	21	115,560	18	46	52,651	17,283	0.33	471	157	53	17
Total	3,060	53,120	26,257	26,863	36,813	16,307	17	276,744	14	32	87,496	28,806	0.33	471	157	29	9
GRAVELLY HILLS, WITH LONG-LEAF PINE.																	
Tuscaloosa	1,390	24,957	12,104	12,853	15,216	9,741	18	111,171	12	30	33,773	11,137	0.33	471	157	24	8
Bibb	610	9,487	4,664	4,823	5,887	3,600	16	43,796	11	36	15,737	4,843	0.31	441	147	26	8
Chilton	700	10,793	5,418	5,375	8,651	2,142	15	40,676	9	28	11,558	3,534	0.31	441	147	17	5
Autauga	660	13,108	6,451	6,657	4,397	8,711	20	81,388	19	37	30,474	7,944	0.26	372	124	46	12
Elmore	630	17,502	8,780	8,722	8,747	8,755	28	73,897	18	42	31,045	9,771	0.31	441	147	49	16
Total	3,990	75,847	37,417	38,430	42,898	32,949	19	350,928	14	35	122,587	37,229	0.30	429	143	31	9

TABLE I.—AREA, POPULATION, TILLED LAND, AND COTTON PRODUCTION—Continued.

Counties.	Area (square miles).	POPULATION.						TILLED LAND.		COTTON PRODUCTION.							
		Total.	Male.	Female.	White.	Color'd.	Per square mile.	Acres.	Percentage of area.	Percentage of tilled lands in cotton.	Acres.	Bales.	Average per acre.			Cotton acreage per square mile.	Bales per square mile.
													Bale.	Seed-cotton.	Lint.		
OAK AND HICKORY UPLANDS, WITH LONG-LEAF PINE.																	
Choctaw	930	15,731	7,750	7,981	7,390	8,341	17	77,182	13	40	31,086	9,054	0.29	414	138	33	10
Clarke	1,160	17,806	8,797	9,009	7,718	10,088	15	77,186	10	43	33,477	11,097	0.33	471	157	29	10
Monroe	1,030	17,091	8,344	8,747	7,780	9,311	17	77,317	12	43	33,463	10,421	0.31	441	147	32	10
Wilcox	960	31,828	15,624	16,204	6,711	25,117	33	161,228	26	48	77,076	26,745	0.35	498	166	80	28
Butler	800	19,649	9,483	10,166	10,684	8,965	25	87,010	17	41	35,851	11,895	0.33	471	157	45	15
Conecuh	840	12,605	6,257	6,348	6,224	6,381	15	46,965	9	35	16,523	4,633	0.28	399	133	20	6
Crenshaw	660	11,726	5,741	5,985	9,118	2,608	18	67,770	16	40	26,962	8,173	0.30	429	143	41	12
Pike	740	20,640	10,157	10,483	14,368	6,272	28	114,850	24	41	47,107	15,136	0.32	456	152	64	20
Coffee	700	8,110	4,025	4,094	6,831	1,288	12	42,126	9	39	16,431	4,788	0.29	414	138	23	7
Dale	650	12,677	6,174	6,503	10,553	2,124	20	68,413	16	40	27,076	6,224	0.23	327	109	42	10
Henry	1,000	18,761	9,251	9,510	11,994	6,767	19	137,348	21	40	54,305	12,573	0.23	327	109	54	13
Total	9,470	186,633	91,603	95,030	99,371	87,262	20	957,395	16	42	399,357	120,739	0.30	429	143	42	13
CENTRAL PRAIRIE REGION.																	
Sumter	1,000	28,728	13,982	14,746	6,451	22,277	29	172,100	27	47	80,662	22,211	0.28	399	133	81	23
Greene	520	21,931	10,823	11,108	3,765	18,166	42	119,426	36	53	63,643	15,811	0.25	357	119	122	30
Hale	670	26,553	13,196	13,357	4,903	21,650	40	140,072	33	50	69,995	18,093	0.26	372	124	104	27
Marengo	960	30,890	15,139	15,751	7,277	23,613	32	169,097	28	48	80,790	23,481	0.29	414	138	84	24
Perry	790	30,741	15,050	15,691	7,150	23,591	39	167,666	33	44	74,303	21,627	0.29	414	138	94	27
Dallas	980	48,433	23,824	24,609	8,425	40,008	49	207,404	33	56	115,631	33,534	0.29	414	138	118	34
Lowndes	740	31,176	15,552	15,624	5,645	25,531	42	181,272	38	54	98,200	29,356	0.30	429	143	133	40
Montgomery	740	52,356	25,563	26,793	13,457	38,899	71	241,570	51	46	112,125	31,732	0.28	399	133	152	43
Bullock	660	20,066	14,345	14,721	6,944	22,122	44	176,860	42	45	80,470	22,578	0.28	399	133	122	34
Macon	630	17,371	8,434	8,937	4,587	12,784	28	133,924	33	42	56,763	14,580	0.26	372	124	90	23
Russell	670	24,837	12,109	12,728	6,182	18,655	37	134,320	31	61	81,582	19,442	0.24	342	114	122	29
Barbour	860	33,979	16,774	17,205	13,091	20,888	40	197,455	36	51	100,442	26,063	0.26	372	124	117	30
Total	9,220	376,061	184,791	191,270	87,877	288,184	41	2,041,166	35	50	1,014,606	278,503	0.27	384	128	110	30
LONG-LEAF PINE REGION.																	
Washington	1,050	4,538	2,341	2,197	2,807	1,731	4	8,936	1	37	3,280	1,246	0.38	543	181	3	1
Mobile	1,290	48,653	23,086	25,567	27,187	21,466	38	8,998	1	.....	1	1	.....	.....	.....	.....	.....
Baldwin	1,620	8,603	4,430	4,173	4,890	3,713	5	7,698	1	18	1,384	638	0.46	657	219	1	.....
Escambia	1,000	5,719	2,933	2,786	4,106	1,613	6	6,934	1	4	278	94	0.34	486	162	.....	.....
Covington	1,030	5,639	2,757	2,882	4,968	671	5	19,326	3	22	4,176	1,158	0.28	399	133	4	1
Geneva	590	4,342	2,198	2,144	3,829	513	7	17,664	5	28	4,947	1,112	0.23	327	109	8	2
Total	6,580	77,494	37,745	39,749	47,787	29,707	12	69,556	2	20	14,066	4,249	0.30	429	143	2	1

TABLE II.—ACREAGE AND PRODUCTION OF LEADING CROPS—Continued.

Counties.	COTTON.		INDIAN CORN.		OATS.		WHEAT.		TOBACCO.		SWEET POTATOES.	
	Acres.	Bales.	Acres.	Bushels.	Acres.	Bushels.	Acres.	Bushels.	Acres.	Pounds.	Acres.	Bushels.
OAK AND HICKORY UPLANDS, WITH LONG-LEAF PINE.												
Choctaw	31,086	9,054	25,613	272,213	3,338	28,432	.....	.....	23	4,322	748	65,545
Clarke	33,477	11,097	28,2[illegible]	312,718	5,065	47,737	7	30	19	2,349	1,256	95,247
Monroe	33,463	10,421	24,135	251,068	4,597	44,024	.....	.....	11	2,496	920	81,893
Wilcox	77,076	26,745	40,053	573,385	7,011	92,933	22	179	15	2,695	1,597	130,591
Butler	35,851	11,895	24,648	274,668	7,494	71,100	10	150	7	2,559	679	67,006
Conecuh	10,523	4,633	20,118	181,277	3,173	25,136	.....	.....	7	1,210	652	54,536
Crenshaw	26,962	8,173	28,099	254,950	5,208	36,480	26	139	33	6,256	558	52,218
Pike	47,107	15,136	42,207	374,170	5,424	38,698	72	408	5	764	883	91,680
Coffee	16,431	4,788	18,668	155,014	2,370	15,025	22	85	5	1,403	474	48,272
Dale	27,076	6,224	31,867	221,497	5,114	28,894	59	336	2	256	872	82,286
Henry	54,305	12,573	48,061	325,846	7,902	63,402	193	906	24	4,499	1,266	112,684
Total	399,357	120,739	332,289	3,196,806	56,696	491,861	411	2,233	151	28,803	9,905	882,558
CENTRAL PRAIRIE REGION.												
Sumter	80,662	22,211	51,402	699,883	2,706	31,380	24	225	13	2,627	1,056	96,402
Greene	63,643	15,811	31,826	402,992	2,103	22,464	314	1,803	41	6,829	705	64,074
Hale	69,995	18,093	43,254	595,185	3,671	45,075	1,437	15,273	16	5,540	1,214	77,830
Marengo	80,700	23,481	43,876	698,069	6,574	83,234	.....	.....	43	7,479	1,138	95,625
Perry	74,303	21,627	48,132	628,248	6,093	63,710	440	2,974	24	4,522	1,107	77,660
Dallas	115,631	33,534	46,542	707,139	8,260	111,213	71	487	13	1,678	2,256	137,287
Lowndes	98,260	29,356	41,109	611,184	3,630	43,922	.....	.....	.....	.....	1,004	68,587
Montgomery	112,125	31,732	62,303	767,427	4,895	62,292	58	393	2	318	1,720	117,285
Bullock	80,470	22,578	47,441	379,876	6,177	43,028	111	455	3	333	773	67,008
Macon	56,763	14,580	23,833	173,969	6,195	53,336	1,916	9,094	6	680	928	60,374
Russell	81,582	19,442	34,335	215,555	9,789	91,141	1,099	6,771	2	303	1,093	80,264
Barbour	100,442	26,063	61,822	437,415	10,264	99,295	131	530	22	3,512	1,274	112,374
Total	1,014,606	278,508	535,935	6,316,882	70,417	750,090	5,601	38,005	185	34,321	14,268	1,054,870
LONG-LEAF PINE REGION.												
Washington	3,280	1,246	4,259	58,105	464	3,547	.....	.....	.....	.....	448	40,695
Mobile	1	1	1,639	25,272	139	1,440	.....	.....	.....	.....	776	58,695
Baldwin	1,384	638	2,041	28,428	350	5,108	.....	.....	1	350	484	50,025
Escambia	278	94	3,699	34,336	869	8,979	.....	.....	.....	.....	494	42,013
Covington	4,176	1,158	10,558	81,997	2,114	16,266	.....	.....	8	1,704	466	43,890
Geneva	4,947	1,112	9,476	58,887	1,705	19,604	.....	.....	4	948	350	33,492
Total	14,066	4,249	31,672	287,025	5,641	45,944	.....	.....	13	3,062	3,018	268,810

PART I.

PHYSICO-GEOGRAPHICAL AND AGRICULTURAL FEATURES

OF THE

STATE OF ALABAMA.

7
17

DEPARTMENT OF THE INTERIOR.

TENTH CENSUS OF THE UNITED STATES.

AGRICULTURAL MAP OF ALABAMA

COMPILED FROM PUBLISHED REPORTS AND MS. NOTES

BY

EUGENE A. SMITH, PH.D.

SPECIAL AGENT

1880.

LEGEND

- Red Clay Lands | a. Metamorphic Region; b. South^{n} Ala. & E. & L.L. Pine
- Gray Gneissic Lands
- Granitic Lands
- Calcareous Shale & Red Valley Lands, Coosa Valley
- Red Lands Tennessee Valley; b. " " of Narrow Valleys of Coosa Val. Region; c. Chunnenuggee Ridge and Hill Prairies | Central Ala.; d. Blue Marl Lands
- Red Ore Ridges; a. Brown Loam Valley Land and Cherty Ridge Lands based on Magnesian Limestone; b. Outlying Areas of Long Leaf Pine, in Coal Fields and Coosa River Valley; c. Long Leaf Pine Hills in S.W. Ala.
- a. Sandy Lands of Mountains, Coosa Valley Region; b. " " " Table Lands & Coal Fields; c. " " " Little Mountain, Tennessee Val
- a. Cherty Lands or Barrens, Tennessee Valley; b. Gravelly Hills with Long Leaf Pine
- Oak and Hickory Uplands with Short Leaf Pine
- Central Prairie Region, Black Belt
- Flatwoods | a. Based on Metamorphic Slates; b. " " Calcareous Shales, Coosa V.; c. " " Lignitic Tertiary Clays
- Lower Prairie Region | a. Lime Hills; b. Red Lime Lands
- Oak and Hickory Uplands with Long Leaf Pine
- Open Rolling Pine Woods and Limesink Region
- Pine Flats
- Alluvial of Mobile River

SECTION OF ANTICLINAL VALLEY, ENLARGED, Showing Details

Scale

0 25 50 75 100 MILES.

Julius Bien & Co. lith.

GENERAL DESCRIPTION OF THE STATE OF ALABAMA.

Alabama is situated between the eighty-fifth and eighty-ninth degrees of west longitude and the thirty-first and thirty-fifth parallels of north latitude. The thirty-fifth parallel makes the northern boundary of the state, and the thirty-first the southern, with the exception of that portion west of the Perdido river, which extends south to the Gulf of Mexico. The form is thus seen to be oblong, with the greater dimension from north to south. The total area thus included is, according to the latest estimates, 52,250 square miles, and the total land surface, 51,540 square miles.

SURFACE CONTOUR.—Leaving out of account the minor irregularities, the surface of the state may be considered as an undulating plain, whose mean elevation above sea-level cannot be much less than 600 feet. Toward the north and east the surface rises above this level, and toward the south and west it sinks below it. The arc of a circle, with Chattanooga as a center, described from the northwestern corner of the state around to the Chattahoochee river at Columbus, would include the area whose general elevation is above 600 feet. The axis of this elevation, which is the southern terminus of the great Appalachian mountain chain, runs northeast and southwest, and the altitude increases toward the northeast. There is thus a general slope away from this elevated region toward all points of the compass from southeast around to northwest. The mountains of the state rest upon this high land, and often reach an elevation above it of 1,200 or 1,500 feet, or above sea-level of 2,000 or 2,500 feet.

The rest of the state outside of the area above mentioned, and whose general altitude is less than 600 feet, has a slope south and southwest toward the Gulf of Mexico and the Mississippi valley. Along this slope the streams have excavated their channels and produced the various topographical features, none of which are due to elevation above the general surface.

RIVER SYSTEMS.—There are, in the most general terms, two things which have determined the drainage system of Alabama. These are, first, the slopes toward the northwest and the southeast, away from the axis of elevation above spoken of; and, second, the more general slope of the surface of the state, taken as a whole, southwest toward the axis of the Mississippi valley. An inspection of the map will show that the latter cause has greatly outweighed the former in fixing the direction of the water-courses, with the result of giving a general southwest direction to the whole drainage system of the state, with the single exception of that of the Tennessee river. In the northeastern part of the state the northeast and southwest direction of the valleys and ridges has also been largely instrumental in turning southwestward (down the valleys) the waters whose natural fall is southeastward at right angles to the axis of elevation of this mountainous region.

Tennessee river.—Looking beyond the limits of the state northeastwardly, we find the Blue Ridge, of which the elevated country in Alabama is but a part, acting as a water-shed between the Atlantic ocean and the Gulf of Mexico. The drainage slopes are therefore toward the northwest and the southeast. At the northwestern foot of this water-shed, in North Carolina, are the headwaters of the Tennessee river. Its natural northwesterly flow is interfered with by the topographical features of the country, the most formidable of which, according to Professor Safford, is the great Cumberland table-land. Parallel with this the river flows through a large part of Tennessee, and, cutting through a detached part of the Cumberland range at Chattanooga, enters the Sequatchie valley, which it follows to Guntersville, in Alabama, where it cuts through the rest of the Cumberland range, and flows thence down the northwesterly slope to its confluence with the Mississippi river. The Tennessee is thus exceptional among the rivers of Alabama.

The Chattahoochee.—This is a boundary stream, and is but slightly related to Alabama, as its headwaters are principally in Georgia. Its tributary streams on the Alabama side are mostly short and insignificant.

The Tallapoosa, Coosa, Alabama, Warrior, and Lower Tombigbee rivers have many things in common. They all have their headwaters in the elevated region above alluded to, and all flow south and southwest into the Gulf of Mexico. In their upper parts, with the exception of the Tombigbee, their flow is alternately southwest down

one of the valleys spoken of, and then south across a ridge to resume their southwestern courses. Where they leave that elevated region (which is in general formed of the tough and hard rocks of the older formations) and pass into the territory formed by the newer and softer rocks there appear the cascades which form the first obstructions to navigation. These falls, or rapids, are seen at Columbus (Georgia), Tallahassee, Wetumpka, Centerville, Tuscaloosa, and Muscle Shoals, on the principal rivers, and at corresponding localities on the smaller streams.

The Coosa river, from Rome, Georgia, down to Greensport, Alabama, flows in general along the strike of the rocks and has no serious obstructions. Below Greensport it turns across these rocks, and rapids are formed, which alternate with stretches of open, smooth waters down to Wetumpka, where the last falls are situated. This river has thus two navigable sections separated by nearly 200 miles of alternating cascades and pools. None of the other rivers in this part of the state are navigable above the lower falls.

The Choctawhatchie and Conecuh rivers, with their tributaries, Pea river, Patsaliga, Sepulga, etc., are all turned southward by a prominent topographical feature known as Chunnenugga ridge, which divides the waters flowing northwestward into the Tallapoosa and Alabama rivers from those flowing southward by various channels into the Gulf. It will be seen that their general direction is west of south, as determined by the general slope of the lower portion of the state.

MOUNTAINS AND TABLE-LANDS.—The mountainous region of the state is confined to the northeastern quarter, as before defined, and the higher portions lie in the eastern half of this area. The valley of the Coosa, from the state line down to the southern line of Shelby and Talladega counties, divides this region into parts which have very different characters. Southeast of this valley are some of the highest lands of the state, and the height of the mountains decreases, as a rule, going southeast. In all this region the summits of the mountains are irregular, and sometimes sharp crested, from the outcropping edges of the generally highly-inclined strata. Northwest of the Coosa valley the mountains are generally level on top, forming table-lands 10 to 15 miles broad, separated by long and narrow valleys. Beyond the Tennessee river these table-lands are cut by erosion into a number of detached peaks, each with a level or nearly level top. These peaks overlook the valleys in steep escarpments, which, especially in the northeast, often attain truly mountainous proportions.

In the lower part of the state there are no elevations which at all deserve the name of mountains, and the highest hills of this region are due solely to erosion—the wasting of the softer rocks by the action of water.

VALLEYS.—Many of the valleys of the elevated region show a close dependence upon the geological structure; and while they are all due to erosion, their position has been in most cases, if not in all, determined by the relative positions of the outcropping edges of the strata of different degrees of hardness.

All the valleys in the mountainous region of the state, like the mountain ranges themselves, have a northeast and southwest direction. The most important of these valleys in many respects is that of the Coosa, which is the southern end of a series of valleys extending from New York to Alabama, and known in New York as the valley of the Hudson, in Pennsylvania as the Kittatinny or Cumberland valley, in Virginia as the Great valley, in Tennessee as the valley of East Tennessee, and in Alabama, as we have just seen, as the Coosa valley. The several outliers of this valley, which separate the parts of the table-lands and coal-fields, belong to the same general system.

The sandstones which form the capping of the mountain plateaus rest upon softer strata of shales and limestones, and the dip of all the strata is at a gentle angle toward the south or southwest, while the river cuts across at nearly right angles. These are the conditions under which escarpments are formed, such as make the southern border of the Tennessee valley across the state.

In the lower part of the state the valleys, like the hills, have very little relation to the geological structure, except in the case of the prairie region, which may be considered as a wide valley, since it is many feet below the hills that border it on the north and south.

CLIMATE.—The most potent influences which determine climate are latitude or distance from the equator, elevation above tide, and configuration of mountain chains, proximity to the sea, and the direction of the prevailing winds. In all these particulars the position of Alabama is favorable for a temperate and uniform climate. The geographical position and the mean elevation of the state have already been subjects of discussion.

Winds.—The prevailing winds during the autumn and winter months are from the northeast and northwest; during the spring and summer, from the southeast; and for the whole year, from the southeast and south, but the yearly mean directions are nearly evenly balanced.

Temperature.—Extremes of temperature are comparatively rare, and the extremes of heat during the summer months are especially moderated by the tempering winds from the Gulf of Mexico. In those parts of the state most remote from the Gulf their elevation above sea-level secures immunity from excessive heat. The mean annual temperature of the state is about 64.58° F. The means for the seasons are as follows: Spring, 63.9°; summer, 79.5°; autumn, 64.5°; winter, 50.4°. The maxima and minima of temperature fall almost without exception in the months of July and January, respectively.

In the lower part of the state, below the latitude of Montgomery, the mean temperature for the winter and for the year are nearly normal; that is, the lines of equal temperature run across the state from east to west, approximately parallel to the lines of latitude, the temperature depending thus almost exclusively upon the latitude.

Above Montgomery, however, two things interfere with this regularity, viz: 1. The cooling influence of the mountains, which has the effect of deflecting the isothermals southward. 2. The heating influence of wide river valleys like those of the Coosa, Warrior, and Tennessee, that are sunk in these highlands. By this cause these lines are carried northward of their normal position.

With these general principles in view, the distribution of the temperature will be readily understood.

The line of mean annual temperature of 68° F. crosses the state just south of Mobile; that of 64° just above Montgomery, curving, however, southward from Montgomery to Eufaula. The line of 60° follows approximately the curve spoken of as running from Columbus, Georgia, around to the northwestern corner of the state; that is, it follows the borders of the elevated or mountainous region, being, however, carried northward by the Coosa and the Warrior rivers and eastward by the Tennessee. The line of 56° is confined to the northeastern corner of the state, but is brought far to the south by the mountain plateau lying between the Coosa and the Tennessee rivers.

The case is similar with the lines of equal temperature for the winter. That of 52° runs nearly parallel with the thirty-first degree of latitude; that of 48° has its normal course through Selma and Montgomery, but is carried by the Coosa river as high up as the crossing of the Selma, Rome, and Dalton railroad at Coosa bridge; and that of 44° follows the margin of the mountainous region, except where it is carried by the Coosa river above Talladega and by the Tennessee river eastward nearly to Decatur. The line of 40° includes only the northeastern corner of the state, to which it is crowded by the Coosa and the Tennessee rivers.

The lines of equal temperature for the summer show much greater irregularity, caused apparently by the preponderating influence of the river valleys. Thus the line of 80° runs diagonally from Tallahassee, in Florida up to Tuscaloosa, by reason of the Alabama, Tombigbee, and Warrior rivers. The line of 78° curves, like some of those above mentioned, around the border of the mountainous region, being considerably indented by the Coosa and Warrior rivers, while it follows the valley of the Tennessee river through the whole of northern Alabama into the state of Tennessee beyond Chattanooga.

In the latitude of Montgomery the last frost occurs, as a rule, between the 5th and the 25th of April, and where the last frost is recorded in March the records show that its actual formation in April was prevented by unfavorable conditions, such as cloudy weather or brisk winds. The first frosts occur usually between the 10th and the 25th of October. When the first frost falls in November, the records always show that some time in October the temperature was sufficiently low for frost, the actual formation of which was prevented by the unfavorable conditions above mentioned.

The influence of topography upon the formation of frost is clearly seen in those parts of the state where the variations in level are considerable; for though both the mountains and the valleys are exposed to the same conditions, and radiation from each goes on at the same rate, the effects of the radiation will be felt in different degrees. As the air is cooled it becomes more dense, and in consequence flows down the slopes to the lower levels, where it accumulates. The elevated lands are thus never exposed to the full intensity of frosts, for their position affords a ready way for the escape of the cooled air, which flows down the slopes as fast as formed, and the reduction of temperature is in this way greatly retarded.

On the other hand, the valleys and lowlands not only retain all the cold air caused by their own radiation, but serve also as reservoirs for the cold air descending from the adjoining heights. The conditions for frost formation are thus greatly increased, and in a degree are proportional to the narrowness of the valley and the height of the adjacent hills.

Since the cotton-plant continues to grow and mature its fruit until cut off by frosts, it is obvious that the length of time between frosts becomes an important factor in determining the fitness of a locality for the production of cotton. Hence mountain lands, even with inferior soils, are steadily coming into favor for cotton planting.

Rainfall.—The supply of moisture for the rainfall of the southern states comes mainly from the Gulf of Mexico, the densest annual precipitation of 60 inches and upward being over the region of the delta of the Mississippi river and along the coasts of Louisiana, Mississippi, Alabama, and western Florida. An area of heavy annual rainfall, 50 inches and upward, spreads thence, with gradually diminishing amount, northeastward, including Louisiana, southwestern Arkansas, western Tennessee, the whole of Mississippi and Alabama, northwestern Georgia, and parts of middle, western, and southern Florida. Along the eastern coasts of Florida, Georgia, and South and North Carolina the influence of the Atlantic ocean is seen in the heavy precipitate of from 55 to 60 inches which falls there.

The distribution of the rainfall in Alabama for the year, and for the winter and summer seasons, is about as follows:

An annual precipitate of 56 inches and upward falls within a belt narrowest in the middle and widening out at both ends, and crossing the state diagonally from the southwestern to the northeastern corner. In the lower part of this belt an area including Mobile and Baldwin and parts of Washington, Clarke, Monroe, Wilcox, Dallas, Lowndes, Butler, Conecuh, and Escambia counties receives an annual rainfall of 62 inches and upward, reaching a maximum of 64 inches at Mount Vernon. In the extreme northwestern corner of the state is another small area whose annual rainfall is above 56 inches. Between these two areas the rainfall is less, falling below 50 inches in

the central part. Eastward of the main belt the amount of annual rainfall decreases, being between 44 and 56 inches over the southeastern part of the state, except in two small areas in Lee and Chambers and in Henry counties, where it ranges between 40 and 44 inches.

During the winter months (December, January, and February) we find the area of maximum rainfall running along the western border of the state within 30 miles of the Mississippi line, except where a branch is thrown off, including parts of Dallas, Wilcox, Lowndes, Montgomery, Butler, Crenshaw, Pike, and Bullock counties, and another deflection toward the east in the Tennessee valley, including parts of Lawrence, Limestone, and Madison counties. Over the rest of the state the winter rainfall is between 12 and 16 inches, except in a small area in the western part of Sumter county and a strip along the eastern border of the state below Chambers county, including parts of Chambers, Lee, Macon, Bullock, Barbour, Dale, Geneva, and all of Henry and Russell counties, where it falls below 12 inches.

During the summer months (June, July, and August) the greatest amount of rain falls south of a line running from the southwestern part of Choctaw county to the upper line of Dallas, and thence southeastward to the southeastern corner of the state, in Henry county. Within the area thus outlined the rainfall is 14 inches and upward, increasing to 18 inches and more in Mobile, Baldwin, Washington, Clarke, Monroe, Butler, Conecuh, Escambia, and Covington counties.

North of the Tennessee river, in Lauderdale, Limestone, Madison, and Jackson counties, we find another area of large summer rainfall, 14 inches and upward, and between the two, over perhaps two-thirds of the state, the summer rainfall falls below 14 inches.

In the meteorological region of which Alabama forms a part there are commonly observed two maxima of precipitation, the principal one about the end of July, the secondary one early in December; also a principal minimum early in October, and a secondary one toward the end of April. The range in Alabama, however, is moderate, and the distribution tolerably uniform throughout the year, as may be seen from the following statement:

The average rainfall of the state is 55.04 inches, and of this 13.86 inches fall during the spring months, 14.07 during the summer, 10.74 during the autumn, and 16.37 during the winter. (*a*)

The records kept at Montgomery show that no periods of wet weather extend over five days, and that when the periods are long heavy rainfalls are exceptional. During the months of March, April, and May thunder-storms are not unusual, and the quantity of rain which then falls is sometimes great. These storms come mostly from westerly directions, from southwest around to northwest, but most often from the southwest. The strong winds with which they are usually accompanied sometimes reach the force of hurricanes or tornadoes, which sweep over the country in a narrow track, usually of less than a mile in width. The tornadoes come almost without exception from the southwest, the wind having a gyratory motion, as is shown by the positions of the prostrated trees.

Snow falls occasionally in the months of January and February. In the lower counties of the state it is extremely rare, but northward there is usually at least one considerable snowfall during the winter.

GENERAL TOPOGRAPHICAL AND GEOLOGICAL FEATURES AND DIVISIONS.—Every geological formation occurring in the Appalachian region of North America has its representatives in the stratified rocks of Alabama, and this state therefore possesses a variety in its geology and topography not excelled by any member of the Union.

The main topographical features of any region are either inequalities of surface, caused by actual folds or wrinkles of the earth's crust, or are due to the degradation of the land by atmospheric or aqueous agencies. The two great factors which determine surface configuration are thus seen to be geological structure and erosion. In all cases difference in the quality of the material acted upon as regards resistance to erosion is an important subfactor, to which are due all those minor inequalities which constitute scenery. By atmospheric and other agencies the rocks decay and are disintegrated, crumbling down into soils, which rest upon and vary with the underlying parent rock, or which are removed by running water or other transporting agent and spread over regions more or less remote from their point of origin. A distinction is thus made between transported or drifted soils and those in place. All bottom or alluvial lands are of the nature of drifted soils, but these are always more or less related in composition to the uplands of the particular drainage basin in which they occur. On the other hand, certain parts of the state have been covered in comparatively recent times with transported soils, resulting from the commingling of the detritus of widely different geological formations, and often bearing very little relation to the underlying or adjacent rock masses. These, the true drifted soils, exhibit local variations which result from the influence of the underlying rocks upon which they have been deposited.

In the present position of the rock strata, whether approximately horizontal or much inclined in the nature of the connection between the topography and the geological structure and in the relations of the soils to the country rocks upon which they rest, are found the characters according to which, for convenience of study and description of its natural features, the state may be marked off into three tolerably distinct divisions: a middle, a northern, and a southern division.

The middle division is the southwestern terminus of a series of folded and faulted strata, which, under the name of the Appalachian chain, extends from the eastern states through Pennsylvania, etc., into Alabama.

a The data for the above account of the climate are derived from the Smithsonian.

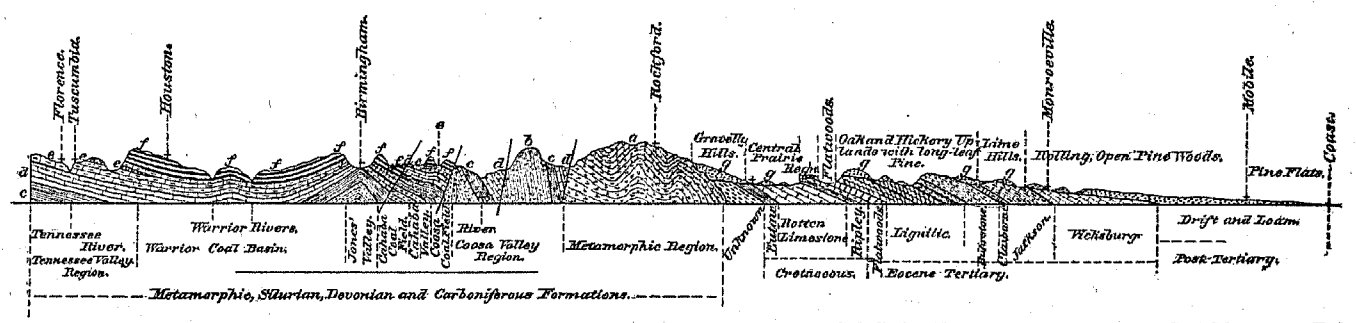
Throughout this part of the state the strata are usually inclined at considerable angles either toward the southeast or the northwest, and their outcropping edges have the general direction of northeast and southwest. The topographical features, ridges and valleys, are disposed in parallel strips or belts, having the same direction as rock strata, to which they owe their origin. With the exception of the bottom and alluvial lands, the soils of this division are in place, resting directly upon the rocks from which they have been derived.

Northwest of this middle division the southern terminations of the great Cumberland table-land and of the highlands of Tennessee extend down into Alabama. These two, together with the Warrior coal basin, constitute the northern division. Here the strata are approximately horizontal, except along the borders of certain outlying folds belonging to the middle division, and the influence of geological structure upon the topography is much less distinctly seen than in the preceding division. The soils, like those of the preceding division, and with the exceptions there noted, have been derived from the disintegration of the underlying rocks of the country.

In the southern division, with approximately horizontal position of the strata, we find the topography very slightly influenced by geological structure, but, on the other hand, almost exclusively the result of erosion, as determined by the differences in the materials of a single formation, the stratified drift or orange sand, which, except in parts of the prairie belt, covers the underlying beds over this whole division. In this division, therefore, the agricultural features depend, with the principal exception of the prairies, primarily upon the quality of these superficial transported beds, and not upon the rocks of the country. Local modifications of these widely-spread drifted soils, as before stated, are not uncommonly brought about by the influence of the underlying rock masses which they cover.

In the detailed descriptions which follow the divisions are taken up in the order previously given, which is also the order of their relative geological ages.

The relations above mentioned are shown by the following general section across the state along the broken line:



a Metamorphic rocks; *b* Silurian (Potsdam) sandstone; *c* Silurian shale; *d* Silurian limestones; *e* Sub-Carboniferous cherty limestones; *f* Coal Measures; *g* Beds of sand, gravel, and loam overlying the Cretaceous, Tertiary, and part of metamorphic rock.

Sandstone. *Shales.* *Metamorphic Slates.* *Limestone.* *Cherty Limestone.*

General section across the state of Alabama from Florence, *southeastward* through Tuscumbia, Houston, and Birmingham to Rockford, Coosa county, and thence *southwestward* through Monroeville, Monroe county, and Mobile to the Gulf coast, showing the disposition of the geological formations and the geographical positions of the agricultural regions, together with their relations to the geological formations.

AGRICULTURAL SUBDIVISIONS OR REGIONS.—Under these general divisions the agricultural features of Alabama will be described in the following order:

MIDDLE DIVISION.

1. The *Metamorphic region*, including—
   - Red lands.
   - Gray lands.
2. The *Coosa Valley region*, with its—
   - Flatwoods.
   - Brown-loam and red-clay lands.
   - Gray cherty lands.

There are also included in this division the Coosa and Cahaba coal-fields, but they are described in detail under the succeeding head.

NORTHERN DIVISION.

3. *Coal Measures region*, including the sandy lands of—
   - The Coosa and Cahaba coal-fields.
   - The Warrior basin and plateau.
4. The *Tennessee Valley region*, the three subdivisions of which are—
   - Barrens.
   - Red valley lands.
   - Sandy lands of Little Mountain range.

SOUTHERN DIVISION.

5. *Oak and pine uplands region*, which includes—
   Oak and hickory uplands, with short-leaf pine.
   Gravelly hills, with long-leaf pine.
   Oak and hickory uplands, with long-leaf pine.
   Still further subdivided into—
   Brown-loam uplands, and
   Pine hills.
6. *Upper or central prairie region*, including—
   Black prairie or "canebrake".
   Hill prairies and Chunnenugga ridge.
   Blue marl lands.
7. *Post-oak flatwoods belt or region.*
8. *Lower prairie region, or lime-hills.*
9. The *Long-leaf pine region*, subdivided into—
   Rolling, open pine woods, with lime-sinks.
   Pine flats.
10. *Alluvial region* of Mobile river and the coasts.

MIDDLE DIVISION.

A line drawn on the map from the northeastern corner of the state southwestward to Tuscaloosa, and thence through Centerville, Clanton, Wetumpka, and Tallassee to Columbus, Georgia, would mark approximately the boundaries of this division.

A part of the Coal Measures of the Warrior field, though falling within the limits above given, is to be classed with the next division, and, on the other hand, Murphree's and Brown's valleys, in Blount and Marshall counties, and the continuation of the last-named valley northeastward along the Tennessee river through Jackson county, though outside these limits, is still to be included in this division, which, as thus defined, has an area of nearly 10,000 square miles, and embraces the following counties and parts of counties: All of Cleburne, Calhoun, Saint Clair, Shelby, Talladega, Clay, Randolph, Chambers, and Coosa, narrow belts through Jackson, Marshall, De Kalb, and Blount, southern Cherokee, most of Etowah, southeastern Jefferson, a small strip along the southeastern edge of Tuscaloosa, northern Bibb, eastern half of Chilton, southern Elmore, Tallapoosa, and Lee.

SUBDIVISIONS.—By reference to a geological map of the state it will be seen that this division includes: 1. The metamorphic region. 2. The valley of the Coosa, together with its outliers, the Cahaba, Roup's, Jones', Wills', Murphree's, and Brown's valleys, and the continuation of the latter along the Tennessee river to the northeastern corner of the state. 3. The Coosa and the Cahaba coal-fields.

These three subdivisions are best described separately.

THE METAMORPHIC REGION.

This being a part of the great Appalachian chain, includes some of the most elevated land in the state in the counties of Cleburne, Randolph, Chambers, Lee, Macon, Tallapoosa, Clay, Coosa, Elmore, and Chilton, comprising an area of 4,425 square miles.

GEOLOGICAL CHARACTERS.—The rocks of this region are the altered and crystallized sediments either of Silurian or preceding ages, and exhibit the greatest diversity, both in their chemical composition, in their physical characters, and in the nature of the topography and the soils to which they give rise. There are all gradations between the hard, almost indestructible quartzites to the easily-eroded marble; from the warm, fertile, and undulating granitic and gneissic land to the much broken, often sterile tracts formed by mica slates and other highly siliceous rocks. With the varying composition of the rocks come varying degrees of resistance to decay and erosion, and hence the great variety in the scenery of this region, where high and almost mountainous ridges alternate with rolling and sometimes rugged lowlands and valleys. In some parts the strata have undergone complete disintegration in place and have been converted into great masses of stratified clays, interlaminated with seams of quartz, which, gradually broken down, cover the ground with their angular fragments.

SOILS.—The depth to which this decay reaches depends on the nature of the rock and its position, and in many instances, even 20 or 30 feet below the surface, the rock is still much decomposed. At the surface a loam with not much appearance of stratification overlies the decayed slates to the depth of several feet in valleys, but much less along the slopes and on the summits. This loam forms the soils and subsoils, which are thus seen to be in most cases directly related to the underlying beds. These soils and subsoils have all probably been slightly shifted from their original place, especially in the valleys, but seldom to that distance where their relationships cannot be readily traced to the underlying or immediately adjacent rock masses.

The two principal soil varieties commonly recognized by the farmers are those which make the gray and the red lands respectively. Of each of these, however, there are numerous subvarieties, exhibiting all grades of color and of fertility. The gray lands may be derived from feldspathic rocks, such as granite and gneiss, in which case they are often quite fertile, or from siliceous mica slates or other quartzose rocks, when they may be almost barren. Similarly, the red lands, when derived from feldspathic rocks, such as hornblendic gneiss, etc., rank high in productiveness, while those resulting from the decay of certain mica or clay slates, bearing garnets or other ferruginous minerals, frequently lie at the other extreme. In the present state of our knowledge it is impossible to mark with accuracy the localities where these several soil varieties occur throughout the metamorphic region; but what can at present be said concerning their occurrence will be found under the head of each county.

Of the true gray granitic (feldspathic) soils there is only a limited area in this state, but a belt of this kind of land passes through Rockford and Bradford, in Coosa county. It is seen again near Blake's ferry, in Randolph, and near Louina, in the same county; then near Milltown, in Chambers county. Indeed, the granite itself, so far as it has yet been observed, passes everywhere, by insensible gradations, into a schistose or stratified rock, or into gneiss, and thus our granitic soils might more properly be classed as gneissic throughout. No analyses of soils from those localities where the so-called granite makes the country are at hand.

The gneisses vary in composition from granitic gneiss to mica-schist, which contains only quartz and mica, and vary in fertility in a corresponding degree. On the other hand, variations brought about by an intermixture of iron-bearing minerals, such as hornblende, garnets, etc., are seen in the hornblendic gneisses and other similar rocks. Throughout the region of occurrence of the gneissic rocks the variations of soils, produced in the manner alluded to, are so numerous, and follow each other in so irregular a manner, as to defy classification and localization, except in the most general way. Thus, it may be said that the gneisses (with all their variations) are of more frequent occurrence in the southeastern half of the metamorphic region, while the more siliceous and argillaceous or clayey rocks prevail, as a rule, in the northwest. Still, such a statement expresses only the most general relations, for rocks of all kinds occur in both divisions.

Of the two principal soil varieties above named, that of the red lands is derived from the decomposed hornblendic gneisses and slates, which in many places, where exposed in washes or gullies, are seen to be merely stratified clays, containing fragments more or less angular of the quartz veins or seams, which are nearly always interbedded with the other rocks of this region. This red soil (the color of which comes from the iron of the hornblende) is considered best adapted to the production of corn and other grains. Its natural growth consists of the various species of oaks (white, post, Spanish, red, and a few black-jacks), hickory, poplar, and some short-leaf pine, especially where the red and gray soils overlap, making mulatto-colored soils. The top stratum of this soil, from 2 to 3 inches in depth, is often a dark chocolate-brown color, but below it becomes a brighter red, and at varying depths, from 10 to 15 feet, becomes a yellowish hard clay. Where the freshly decomposed rocks are seen the color is yellowish rather than red, the latter color being darker and more intense apparently the further removed the soil is from its original position and the more it is affected by the decay of the vegetable matter. When first cleared, these lands were thought to be the best in the country, and many fine farms are still found upon them. The majority of the farmers now, however, seem to prefer the gray soil, as being more certain, more easily tilled, and even more fertile. The red lands were the first to be cleared up by the original settlers, and most of the older farms and fine old country residences are upon this kind of land.

The gray soils result from the disintegration of gneisses and mica slates which contain comparatively little or no hornblende or other iron-bearing minerals. They are commonly somewhat sandy, usually light-colored, gray to dark gray, sometimes nearly black, with very often, however, a decidedly reddish color similar to that of the hornblendic soils above described. Fragments of the partially-decayed gneiss of a light-gray color often lie embedded in reddish and even red clays or clayey sands. These gray soils are easily tilled, are certain of crop even with moderately favorable seasons, and are better suited than the red to the culture of cotton. Below some three or four inches of dark gray sandy top soil there is usually a lighter colored but somewhat yellowish subsoil. The timber is much the same as that upon the red lands, viz, oaks and hickory, with a few short-leaf pines.

The subjoined analyses will show the chemical characters of these two soil varieties:

No. 78. *Red lands soils* from 6 miles north of Opelika, Lee county (S. 16, T. 20, R. 27 E.). Depth, 10 inches; vegetation, red, Spanish, and post oaks, hickory, and a few short-leaf pines; color, dark-red.

No. 79. *Gray gneissic (isinglass) soil* from 6 miles north of Opelika, Lee county (S. 17, T. 20, R. 27 E.). Depth, 8 inches; vegetation, red, Spanish, and post oaks, hickory, and a few short-leaf pines; color, grayish-brown.

Gneissic soils, Lee county.

	RED LANDS SOIL.	GRAY LANDS SOIL.
	No. 78.	No. 79.
Insoluble matter	68.710 } 72.540	79.170 } 82.426
Soluble silica	3.830 }	3.256 }
Potash	0.350	0.268
Soda	0.119	0.067
Lime	0.043	0.167
Magnesia	0.050	0.130
Brown oxide of manganese	0.100	0.093
Peroxide of iron	10.740	3.144
Alumina	9.237	5.120
Phosphoric acid	0.170	0.229
Sulphuric acid	0.080	0.043
Water and organic matter	7.011	7.742
Total	100.440	99.429
Hygroscopic moisture	7.40	4.54
absorbed at	27.8 C.°	26.7 C.°

Of these two soils, in proportion to the amount of insoluble matter, the gray is decidedly better in respect of potash, phosphoric acid, and lime, and is probably more thrifty. The red soil is rather deficient in lime, but in retentiveness of moisture it is superior to the other. Both are fairly good soils.

Running northeast and southwest through the metamorphic area near the southern border there is a belt of varying width, in which hydromica slates, often highly graphitic, are of frequent occurrence. These mica slates are usually filled with garnets, are much decomposed, and alternate with thin beds of clay slate, which is occasionally so highly graphitic as to be used as lubricating material. In Randolph and Tallapoosa counties these rocks are abundantly found, and details of their occurrence will be found under those headings. The soil derived from these rocks is of yellowish-gray color, finely pulverized, and supports a growth of the usual upland character.

Mica slates containing the common micas, such as muscovite and biotite, are also of frequent occurrence, and the soils yielded by them are also of varying degrees of fertility, being between a first-rate gneissic soil, on the one hand, and a poor sandy material on the other. These variations have already been the subject of remark under the heading of the gneissic soils.

As to the distribution of these mica slates no general rule can be given, since they alternate in so many ways with the other metamorphic rocks. The following analyses are probably fairly characteristic of these two varieties:

No. 107. *Mica slate soil* (graphitic, hydrous mica) from 4 miles north of Roanoke, Randolph county. Depth, 8 inches; vegetation, black, red, post, and black-jack oaks, with a few short-leaf pines and hickories; color, light-yellow.

No. 103. *Mica slate soil* (garnetiferous, common mica) from S. 27, T. 19, R. 7 E., Clay county. Depth, 8 inches; vegetation, black, red, and Spanish oaks, with a few hickories and chestnuts; color, buff-yellow, passing downward into orange. The subsoil is a tolerably stiff red clay.

Mica slate soils.

	RANDOLPH COUNTY.	CLAY COUNTY.
	Mica slate soil (graphitic, hydrous mica).	Mica slate soil (garnetiferous, common mica).
	No. 107.	No. 103.
Insoluble matter	77.354 } 81.340	66.174 } 75.437
Soluble silica	3.986 }	9.263 }
Potash	0.536	0.351
Soda	0.086	0.246
Lime	0.010	0.038
Magnesia	0.145	0.155
Brown oxide of manganese	0.146	0.151
Peroxide of iron	6.801	9.303
Alumina	5.693	8.083
Phosphoric acid	0.067	0.137
Sulphuric acid	0.057	0.090
Water and organic matter	4.772	5.706
Total	99.713	99.697
Hygroscopic moisture	4.612	5.91
absorbed at	7.2 C.°	6.1 C.°

Both these soils are deficient in lime, and No. 107 is also deficient in phosphoric acid. The rock from which No. 107 is derived has usually been called "talcose slate", but a full analysis shows that it contains only a small percentage of magnesia. Soils like No. 107 are quite common throughout the "gold regions", which, as is well known, does not rank as the best farming country. The rock from which No. 103 is derived contains the ordinary mica, and is filled with garnets of large size, often as much as 2 inches in diameter. This soil is fairly productive in good seasons, but cannot stand much dry weather, and, being rather light, soon wears out. It is a good representative of the better class of mica slate soils, and does not exhibit the sterility characteristic of some of them, especially those derived from a mica slate of a purple color running through Cleburne, Clay, and Coosa, into Chilton county, and which are almost barren, supporting a growth consisting almost entirely of stunted long-leaf pines and black-jacks.

A comparison of the four analyses given on page 16 shows that the soils may be divided into two general classes, viz, sandy and clayey or loamy. To the first belong the two gray soils, *i. e.*, the gneissic and the hydromica; to the second, the red soils, *i. e.*, the hornblendic and the mica slate; and, in the most general terms, the soils of this region are usually grouped under one or the other of two heads, as sandy or gray, and as loamy or red soils. In some rare instances we have loamy or clayey soils which are deficient in red coloring matter, but as a general thing the clayey and the ferruginous matters are closely associated.

This close agreement of the soils in composition, though derived from rocks of different kinds, bears out what was said concerning the relations between the different rocks themselves; for since the great majority of the rocks of this region may be classed with the gneisses, and as these vary in the one direction, by the accession of hornblende or other iron-bearing minerals, through hornblendic gneisses to almost purely hornblendic slates, so the corresponding soils pass from light-grayish colors through the various grades of yellow to deep red; and since the increase in the amount of hornblende is usually attended with a decrease in the amount of free quartz or silica, it is easily seen that these soils are less and less distinctively sandy as they pass from light to red colors.

Variations in the gneisses take place in another direction by the gradual disappearance of the feldspar and the corresponding increase in the proportion of quartz and mica, as when the gneiss passes into mica slate. In this series the light-colored feldspathic soil gradually loses its fertility, becoming more sandy and sterile till the sandy micaceous soils of the typical mica slates are reached. No analyses are yet on hand of the clay slate soils.

THE COOSA VALLEY REGION AND ITS OUTLIERS.

The wide valley, with prevailing calcareous rocks, which lies between the metamorphic area on the one hand and the southeastern edges of the Coosa and Cahaba coal-fields and Lookout mountain on the other has received the name above given from the Coosa river, which traverses its whole length. Geologically it is the continuation of the valley of eastern Tennessee; and, indeed, the valley of which this is a part, and which has been described by Professor Safford as a complex trough fluted with scores of smaller valleys and ridges, extends at least from the Susquehanna river to middle Alabama.

The main valley of the Coosa, with the limits above given, is from 15 to 20 or 30 miles wide, and is closely furrowed with parallel valleys and ridges, all trending northeast and southwest. This valley is embraced in the counties of Cherokee, Cleburne, Calhoun, Etowah, Saint Clair, Talladega, Shelby, Coosa, and Chilton, and has an area, including its ridge lands, of 2,580 square miles. Several outlying valleys, with very similar geological structure and soil varieties, may be most conveniently described in connection with it.

These outliers are: 1. The Cahaba valley, lying between the Coosa and Cahaba coal-fields, in the counties of Saint Clair, Jefferson, Shelby, and Bibb, its area being 385 square miles. 2. Roup's and Jones' valley, between the Cahaba and Warrior coal-fields, in Jefferson, Tuscaloosa, and Bibb counties; area, 285 square miles. 3. Wills' valley, between Lookout and Sand mountains, in De Kalb, Etowah, and Saint Clair counties; area, 460 square miles. 4. Murphree's valley, in Etowah and Blount counties; area, 110 square miles. 5. The Blount springs, or Brown's valley, which is a prolongation into Alabama of the Sequatchie valley of Tennessee, and runs through Jackson, Marshall, and Blount counties, having an area of about 460 square miles.

GEOLOGICAL FORMATIONS.—The strata which appear at the surface and contribute to the formation of the soils in all these valleys are the representatives of all the geological formations occurring in Alabama, from the primordial or lowest division of the Lower Silurian up to the base of the Coal Measures. In the following statement is given, in descending order, the names and geological positions of these strata, so far as their equivalence has been made out:

Carboniferous.....	7. Coal Measures of the Warrior, Cahaba, and Coosa fields.	
Sub-Carboniferous.	6. Upper, Calcareous, mountain limestone.	
	5. Lower Siliceous, siliceous group.	
Devonian	4. Black shale.	
Upper Silurian....	3. Clinton or Red Mountain group.	
Lower Silurian....	2. Trenton and Chazy, shales and limestones.	
	1. Calciferous and Potsdam..	*e.* Dolomite or magnesian limestone.
		d. Shale (calcareous shales).
		c. Upper sandstone (calcareous sandstone).
		b. Potsdam sandstone proper.
		a. Semi-metamorphic shales and conglomerates.

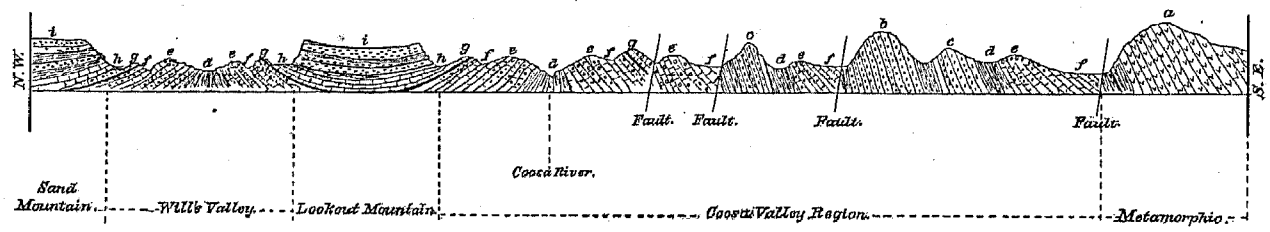
The lithological and other characters of these different formations, so far as they are of importance from an agricultural point of view, will be given in the special description of the soils.

COOSA VALLEY.

Under this name is included that belt of 30 or 40 miles width east and west lying between the metamorphic area on the one hand and the Coal Measures on the other, and extending from the eastern border of the state, in the counties of Cherokee and Calhoun, southwestward for 120 miles.

With reference to these mountainous borders it may be considered as one valley, but in reality it consists of several parallel valleys separated by ridges of greater or less height. The highest of these ridges are found in the southeastern part of the valley, where they attain true mountainous proportions.

Section from Sand mountain, on the northwest, to the metamorphic region on the southeast: showing the geological structure of the Coosa Valley region, Lookout mountain, and an outlying anticlinal valley (Wills').



EXPLANATION.—*a.* Mountains of the *Metamorphic region*. *b.* Sandy mountain lands—*Potsdam sandstone*. *c.* Ridgy lands of the *Upper Sandstone*. *d.* Red valley lands of the *shale* and the lower part of the *Magnesian limestone*. In the Coosa River region and central parts of Wills' valley the shale forms "flatwoods". *e.* Loams and cherty gravelly ridge lands, based on the *Magnesian limestone*. *f.* Brown loams of the valleys, based on *Trenton limestone*. *g.* Red ore ridges. *Silurian* sandstones and ore on one side and *sub-Carboniferous* cherty limestones on the other. The cherty gravel covers the side next to the Coal Measures. *h.* Brown loams of the valleys, based on *sub-Carboniferous* limestones. *i.* Sandy lands of Lookout and Sand mountains, *Coal Measures*. The sandstones, etc., of Coal Measures form the borders of the anticlinal valleys.

The structure of the Coosa Valley region, as well as that of an outlying anticlinal valley, will be easily understood by an examination of the accompanying sketch, which represents a section from Sand mountain, across Wills' valley, Lookout mountain, and Coosa valley, to the mountains of the metamorphic region. The section is taken from northwest to southeast, at right angles to the general direction of the strata, and the sketch does not pretend to give the minute details of structure, but only its broad outlines, and it is therefore in great degree diagrammatic.

The structure of the Coosa valley varies with the locality. From the Georgia line down to Gadsden it consists of two parts, the western being a large anticlinal, and the eastern being formed of strata repeated by faults. The eastern side of the anticlinal is itself cut short by a fault. Below Gadsden the anticlinal turns westward from the river, and is merged into Jones' valley, while the Coosa valley proper is altogether within the area of the faulted series.

The sketch, taken together with the lithological and topographical characters given in connection with the special description of the soils, will show very clearly the part borne by each formation in the production of the topographical features of this valley. It will be noticed that the ridges are of four kinds, viz: in the anticlinal, the red ore ridges, usually steep, with chert fragments on one side and sandstone and limestone on the other; the ridges of the dolomite, rounded and covered with masses of chert. In the eastern part of the Coosa valley the ridges are the chert ridges of the dolomite, the sandstone ridges of the upper sandstone, steep and sharp-crested, but not high, and lastly the mountains of Potsdam sandstone.

The valley-making formations are the sub-Carboniferous in part, the Trenton and Chazy, the calcareous parts of the dolomite, and the shale. The first of these (sub-Carboniferous) is found only in the anticlinal part of the valley; the others are found in both parts. The immediate valley of the river as far south as Gadsden is underlaid by the shales, covered, however, in great measure, with the sands and pebbles of a later period. The dolomite, as usual, forms the greater part of the superficial area of the ridgy valleys on each side of this central portion, and, from an agricultural point of view, is perhaps the most important formation. (*a*)

OUTLIERS OF THE COOSA VALLEY.

Cahaba valley.—This valley lies between the Coosa and Cahaba coal-fields. In its geological structure it resembles the eastern part of the Coosa valley, for a fault on its western edge brings the upper sandstone up to the level of the Cahaba Coal Measures, and going thence eastward we pass, in ascending order, over the following strata: Upper sandstone, the shale, the dolomite, Chazy and Trenton, Clinton, black shale, sub-Carboniferous, and Coal Measures (Coosa field). As in other cases, the greater part of the area of the valley is made by the strata of the magnesian limestone or dolomite.

Roup's and Jones' valley.—These names are given to the two ends of the valley lying between the Cahaba and the lower part of the Warrior field, merging into the Cahaba and Coosa valleys above Springville.

Wills' valley, Murphree's valley, and Brown's valley.—There are troughs sunk in the Coal Measures of the northeastern or plateau division of the Warrior field. In structure these are all, with the exception of the Cahaba valley above described, anticlinal folds in the Warrior measures, furrowed out subsequently by erosion. While the

a In the sketch the dolomite does not occupy its proper proportion of the area.

floors of these valleys are much lower than the rims which bound them (for the folding involved also the strata of the Coal Measures for a short distance on each side), they are nevertheless considerably higher than the synclinal basins of the Coal Measures, between which they lie, and for that reason water rising in these valleys sooner or later breaks through the mountain rim and flows off into the streams which drain the basins.

Exceptions to this general statement are found in what has been termed the plateau region of northeastern Alabama, and an examination of the map will show that the tributaries of the Tennessee in Marshall and De Kalb counties rise on the plateau near the edge of Wills' valley, flowing down and across the plateau, while the streams rising in the valley flow along it to each end of the same and do not break across the Coal Measures on either side.

The section on page 18 represents in a general way the geological structure of all these valleys, and shows with sufficient distinctness the parts borne by each of the formations appearing in them, determining their topography, the remarks under the Coosa valley applying here also. The structure is, however, especially in the southwestern part of this region, rarely so simple as is represented in the section, for the anticlinal fold has in some cases been thrust or lapped over toward the northwest, thus causing some of the more recent formations to lie beneath the older, and in addition to this, by reason of a fault or break in the strata, the red-ore ridge, on the western side of the valley, has been duplicated. This duplication of the Red mountain is characteristic of the valley from the upper edge of Tuscaloosa county nearly through Jefferson. On the western side of the valley also the strata are usually very nearly vertical, and a very prominent ridge is made by the thick bed of a conglomerate which lies at the base of the Coal Measures. At a short distance from this ridge the strata of the Warrior measures have their usual nearly horizontal position.

The red-ore ridges are commonly of very unequal size on the two sides of the valleys, rising to the dimensions of small mountains on one side, while on the other they are so insignificant in size as to be often overlooked entirely.

SOILS OF THE COOSA AND OUTLYING VALLEYS.—Classified according to color and general physical characters, the soils occurring in these valleys are either red or brown loams derived from the pure calcareous formations, such as parts of the shale, the dolomite, Trenton, and sub-Carboniferous; or lighter colored to gray siliceous soils, usually filled with angular, flinty gravel, and resting on a yellowish clayey subsoil derived from cherty limestones of the dolomite and of the sub-Carboniferous; or the light sandy loams which result from the disintegration of sandstones such as make up the greater part of the Potsdam proper, the upper sandstone, and the Coal Measures. But since the soils of each of these classes vary according to the geological formation to which they owe their origin their discussion in connection with these formations will best bring out their peculiarities of composition and explain their distribution in the valleys.

Acadian slates and conglomerates.—These have received notice under the preceding division, since they are more or less metamorphosed and crystalline in texture, and are otherwise closely associated with the true metamorphic rocks.

Potsdam sandstone.—The principal rock of this group has already been mentioned as a rather coarse-grained sandstone, and hence the resulting soil is sandy. In many places the soil is thin and vegetation scanty and stunted, but occasionally the growth is vigorous, consisting of the upland oaks, chestnut, and short-leaf pine. By reason of the mountainous character of the country made by these rocks very little of this soil is under cultivation, but there are many spots of good grazing ground. The Potsdam sandstone, in a series of outlying mountains, forming an interrupted chain, skirts the western border of the metamorphic region and extends through the counties of Cherokee, Calhoun, and Talladega.

Upper sandstone.—The soils derived from this formation are usually somewhat calcareous, though sandy, but the sharp-crested, steep ridges to which they are confined are seldom under cultivation. The entire thickness of the formation is inconsiderable, and as the strata usually lie tilted at high angles the superficial area occupied by them is quite limited. Isolated ridges of these rocks are found in the Coosa valley, in the counties of Cherokee, Calhoun, and Talladega, and in the Cahaba valley in Shelby and Saint Clair counties. Besides these occurrences, the mountains of Potsdam sandstone above described have usually a narrow border of these rocks on their eastern slopes.

The shale.—This formation in its outcrops presents two well-marked phases. Its lower beds are mostly shales, which, at the surface, have been thoroughly leached of calcareous matter, and generally break up into small fragments having very much the appearance of shoe-pegs. The colors of these shales are chocolate-brown, red, greenish, and gray. The soils formed from these materials are usually thin, and, though considered productive in good seasons, are liable to injury from drought. The timber is a mixture of chestnut, red, and white oaks, dogwood, and hickory. The valleys occupied by these variegated shales are ridgy, the shale ridges being often almost bare of soil. Areas of these shales are usually associated with the outcrops of the upper sandstone, with the upper strata of which they are closely related lithologically, and characteristic occurrences are not infrequent in Bibb county, northeast of Centerville, near Pratt's Ferry, in the vicinity of Montevallo, and Helena, in Shelby, and along the southeastern flanks of the isolated ridges of the upper sandstone and the mountains of Potsdam sandstone in Talladega, Calhoun, and Cherokee counties.

On the other hand, the upper strata of the formation are frequently thin sheets of limestone, alternating with seams of clay and with thin beds of sandy and aluminous shales. These beds often occupy the central parts of the anticlinal valleys as a mass of greatly contorted, usually nearly vertical strata, of which the thin-bedded limestone forms the greater part, the shales and clay being mostly weathered out, giving rise to a stiff clayey soil, through which the edges of the limestone protrude.

Flatwoods.—Where the clayey portions predominate and the drainage is defective level tracts are formed, which are known as "flatwoods", and which are usually uncultivated, though the timber indicates a soil by no means sterile. The prevailing timber of the flatwoods is post oak and short-leaf pine. The soils are usually of a greenish-yellow color, sometimes red in places, and occasionally nearly black. Where roads cross the flatwoods they are easily cut up into deep, muddy ruts, in which water stands for a long time. Occasionally a high place may be encountered with sandy soil and under cultivation, but these spots form a very small proportion of the whole area of the flatwoods.

Some of the largest bodies of flatwoods are found in the anticlinal part of the Coosa valley below Gaylesville, in Cherokee county, extending down to Gadsden (well exposed below Cornwall, at Cedar Bluff, and below Round mountain), and thence below Gadsden, in the direction of Springville, nearly to the latter place; also in Jones' valley between Elyton and Jonesboro', and in small patches farther south in Jones' and Roup's valley.

In the immediate valley of the Coosa river the shales have usually a superficial covering of sand and pebbles belonging to a much more recent formation, but along the river bluffs they may be seen underneath the surface beds. Throughout these flatwoods the outcroppings of the limestone are frequent, and in places there is very little soil, the rocky surface being then usually occupied by cedar glades. Similar glades are also often formed by the shaly limestones of the Trenton period.

From the flatwoods between Springville and Gadsden a specimen of soil was collected which may be considered as a representative. The analysis is as follows:

No. 70. *Flatwoods soil* (the Lower Silurian shale) from 3 miles northeast of Asheville, Saint Clair county. Depth, 10 inches; vegetation, chiefly post oaks and short-leaf pine, with red, Spanish, and a few black-jack oaks. Color, gray on top, changing within 3 inches to buff-yellow.

Flatwoods soil (Lower Silurian shale).

	No. 70.	
Insoluble matter	70.650	
Soluble silica	8.933	79.583
Potash		0.277
Soda		0.078
Lime		0.159
Magnesia		0.478
Brown oxide of manganese		0.079
Peroxide of iron		0.528
Alumina		7.497
Phosphoric acid		0.075
Sulphuric acid		0.013
Water and organic matter		4.777
Total		99.544
Hygroscopic moisture		11.15
absorbed at		27.2 C.°

The analysis shows that this is not such an inferior soil as its total neglect by the farmers would indicate, although the phosphates and vegetable matter are low. The natural growth, also, which is of fine, sturdy trees, tells in its favor. Many soils are successfully tilled which have no better chemical composition than this. Physically, however, it is too heavy and cold for cultivation, except where mixed with sand, as is the case near the banks of some of the streams which traverse it. Almost the only inhabitants of the flatwoods are to be found along these water-courses. During the winter and spring, by reason of mud and holes, the roads are almost impassable. In its uppermost portions this formation exhibits very similar strata to the lowest beds of the next succeeding, there being no well-defined line of demarkation between them.

The great body of deep, red-colored, clayey loams occurring in the Coosa Valley region, and especially in its eastern part, may be assigned, as to their origin, either to the lowermost of the beds of the shale or to the uppermost of the dolomite. They will be more particularly described under the next head, though in part, without doubt, belonging here.

The magnesian limestone, or dolomite.—This in Alabama has the widest distribution of any of the calcareous formations, and for this reason, and because it underlies a large proportion of the cultivated valleys in this part of the state, its importance from an agricultural standpoint is very great. It has been stated that the lower beds of the dolomite are more calcareous, the upper, as a rule, siliceous or cherty, and the resulting soils in their extremes are of two kinds:

1. A clayey loam of light-yellowish to orange-red colors and of varying thickness, the average being perhaps one and a half feet. The subsoil is usually heavier, being a rather stiff clay or clay loam of a red or yellow color. Both soil and subsoil are often filled with lumps of limonite or brown iron ore. Beneath the subsoil, at varying depths, lies the dolomite or limestone. There is a great variety in the color of the top soil between a very light-yellow, almost gray, and a deep red and brown, but the subsoil is commonly a yellow or red clay, and it is not unusual to find these soils and subsoils, especially those of lighter colors, filled with angular fragments of chert.

The characteristic timber upon the red lands is red, Spanish, post, and black-jack oaks, hickory, short-leaf pine, and dogwood; in low grounds, sweet gum and sour gum in addition to the above.

Some of the best farming lands in the state are based upon these lower beds of the dolomite and upon the immediately underlying calcareous parts of the shale, and their widest distribution is to be seen in the eastern part of the Coosa valley, in Cherokee, Calhoun, and Talladega counties, and southward, in the same direction, in Shelby and Bibb counties. The greater part of the red and brown loams with deep red-colored subsoils occurring along the eastern border of this long series of valleys is derived from the dolomite, but red and brown loams of a somewhat similar nature are also derived both from the shale below and from the Trenton rocks above the dolomite. In the anticlinal valleys these lower beds of the dolomite do not form the surface to so great an extent, and the deep red soils are of less frequent occurrence than in the Coosa valley.

2. The upper siliceous beds of the dolomite, in disintegrating, yield as a rule gray soils, which are filled with angular chert fragments. The subsoils are mostly of a yellowish to red color and of clayey substance, though the clayey substratum may sometimes lie at considerable depths below the surface. The agricultural characters of the lands made by these upper beds vary between wide limits, from good brown loams on the one hand to gray siliceous and nearly barren soils on the other.

The cherty portions of the dolomite, from the weathering away of the calcareous part, gradually accumulate and protect the strata from further erosion, and in this way the chert ridges so characteristic of the formation originate. The chert, which is of concretionary nature (and not bedded), occurs sometimes in masses of great size, and the surface of the hills is so covered as to leave very little soil exposed, and that of a highly siliceous character. In such cases the growth is chiefly of long-leaf pine and black-jack oak. The broad chert ridges of the Coosa valley in Cherokee, Calhoun, Talladega, and Shelby counties are very commonly timbered with the long-leaf pine.

Occasionally the country formed by this part of the dolomite is rolling or slightly broken, rather than hilly, varied with lime-sinks and outcrops of the cherty dolomite. The southwestern part of Talladega county, near the Coosa river, furnishes a good example of these rolling piny woods, which in many respects remind one of the rolling piny woods of the southern counties. Such soils have little to recommend them, and we find the country almost uninhabited, except along the banks of the streams which drain it, and these are few in number. Where the chert is less prominent as a surface material the gray lands are frequently of very fair quality, and, while not so fertile as some of the red lands, are thought to be better adapted to the cotton crop, especially where commercial fertilizers are used.

The better grades of the gray, gravelly lands are timbered with oaks and short-leaf pine, hickory, dogwood, etc., while those of a sandier nature have the long-leaf pine, associated with post, Spanish, and black-jack oaks and small hickories. The gray pine lands near the Alabama furnace, in Talladega county, may be taken as types of this last-named variety.

In the outlying valleys there is always at least one of these chert ridges occupying the center of the valley, but it is more commonly separated into two by a narrow valley resting on the more calcareous lower parts of the dolomite, or by a belt of flatwoods derived from the underlying shales. These ridges are timbered usually with post, black-jack, and Spanish oaks, with some chestnut and short-leaf pine. The long-leaf pine is also found where the siliceous matter preponderates. Occasionally the cherty matter assumes the form of a sandstone or conglomerate, which forms considerable hills. This is best seen in the Salem hills, near Jonesboro', in Jones' valley, and again a few miles southwest of Springville, in Saint Clair county. The Salem hills have a characteristic growth of long-leaf pine, as yet untouched by the woodman's ax.

The chemical composition of typical soils derived from the rock varieties occurring in the dolomite are fairly exhibited in the analyses of four red-loam soils and one gray, cherty soil taken from several localities. Only the better soils, such as are under cultivation, have been examined. The barren soils of the chert hills and pine woods are not often in cultivation, and have not, therefore, been selected for analysis. In Calhoun, Talladega, Shelby, and Bibb counties the red soils appear most prominently.

No. 71. *Red valley soil* from 1½ miles south of Jacksonville, Calhoun county. Depth, 12 inches; vegetation, red, Spanish, and post oaks, hickory, dogwood, and short-leaf pine; color, dark-red. This kind of soil occurs over a good proportion of the valley below Jacksonville and around Alexandria.

No. 76. *Red valley soil* from near Mrs. Walker Reynolds' place, Talladega county. Depth, 12 inches; vegetation, red, Spanish, white, and post oaks, sweet and sour gums, and hickory; color, dark-red. This is a fair sample of the red soils which make the valley of Talladega one of the most beautiful parts of the state. The same soils are seen farther south, in Shelby and Bibb counties, those around Montevallo being of this nature.

No. 45½. *Red upland soil* (dolomite) from near Pratt's ferry, Bibb county. Depth, 12 inches; vegetation, white, black, post, and other oaks, chestnut, hickory, walnut, mulberry, dogwood, with occasional black gum and cedar; color of soil, brown; of subsoil, reddish-brown.

No. 67. *Little Cahaba valley soil* (dolomite) from 6 miles southwest of Springville, Saint Clair county. Depth, 12 inches; vegetation, red, black, and Spanish oaks, hickory, chestnut, sweet gum, and persimmon; color, reddish-brown.

No. 69. *Gray upland soil* (dolomite), 1 mile north of Ashville, Saint Clair county. Depth, 10 inches; vegetation, red and Spanish oaks, poplar (*Liriodendron*), dogwood, and short-leaf pine, with some sweet gum and persimmon; color, brownish-gray. Both soil and subsoil are commonly filled with angular fragments of chert.

Magnesian limestone soils (Lower Silurian).

	CALHOUN COUNTY.	TALLADEGA COUNTY.	BIBB COUNTY.	SAINT CLAIR COUNTY.	
	Red valley soil.	Red valley soil.	Red upland soil.	Little Cahaba valley soil.	Gray upland soil.
	No. 71.	No. 76.	No. 45½.	No. 67.	No. 69.
Insoluble matter	80.520 } 84.461	64.070 } 71.717	81.480 } 88.010	73.433 } 80.892	83.440 } 87.670
Soluble silica	3.941 }	7.647 }	6.530 }	7.459 }	4.230 }
Potash	0.290	0.330	0.328	0.240	0.109
Soda	0.062	0.111	0.027	0.041	0.018
Lime	0.112	0.091	0.255	0.225	0.202
Magnesia	0.260	0.143	0.210	0.476	0.181
Brown oxide of manganese	0.057	0.137	0.189	0.241	0.042
Peroxide of iron	5.011	7.157	2.016	5.518	2.178
Alumina	5.722	11.229	5.614	7.498	4.521
Phosphoric acid	0.126	0.176	0.110	0.165	0.093
Sulphuric acid	0.056	0.010	0.167	0.007	0.048
Water and organic matter	4.501	8.298	3.587	4.719	5.301
Total	100.058	99.408	100.513	100.022	100.363
Humus		0.984			
Available phosphoric acid		0.020			
Hygroscopic moisture	8.003	19.400	4.528	9.525	8.528
absorbed at	26.7 C.°	24.4 C.°	28.3 C.°	7.2 C.°	26.7 C.°

In comparing these soils with each other it is seen that they are all tolerably good soils, having an adequate supply of available potash (except in the case of No. 69), phosphoric acid, and also of lime and magnesia. In these respects the red soils, as a class, are superior, but the gray soil has on its side the advantage of being more easily tilled, as it is thrifty because of a large percentage of lime, and is generally considered a safer soil. No. 76 is rather deficient in lime, and also in available phosphoric acid. In retentiveness of moisture the upland soil (No. 45½) is a little deficient, and in its composition also it approaches closely to the gray soil.

The soils which most resemble the above are those of the Tennessee valley, in which there are the two varieties of red and gray, bearing to each other about the same relations as are seen in the above analyses. The Tennessee valley soils are, if anything, slightly better than those of the region we are discussing.

In the county descriptions will be found fuller discussions of the qualities of these soil varieties from the farmers' standpoint.

Chazy and Trenton.—The lowermost of the Trenton rocks are impure argillaceous limestones and purer blue limestones, the upper calcareous shales. As a rule, the limestone predominates, and the prevailing soils are, therefore, good strong loams, somewhat calcareous and resembling the soils of the lower part of the dolomite, or those of the Saint Louis group of the sub-Carboniferous. The formation as a whole is valley-making, but the lower beds, which are often aluminous, frequently form low, rounded hills, along the sides of which the strata outcrop in long step-like ledges. In such cases they are usually covered with a growth of cedars.

In the subordinated valleys in the eastern part of the Coosa valley the Trenton rocks are usually associated with those of the dolomite, the latter commonly forming the northwestern and the former the southeastern side of the valley range; but the dolomite, as a rule, far exceeds the Trenton in superficial extent. In the anticlinal valleys the Trenton rocks are found as a narrow belt on each side of the central area of dolomite and shale. In many instances they may be found high along the sides of the ridges of the Clinton or Red Mountain group, even occurring nearly up to the summits of some of them. The outcropping ledges of limestone are then usually covered with a dense growth of cedars, and the name of Cedar mountains commonly given to them is not inappropriate. In the valleys also there are frequent patches of the rocks nearly bare of soil and forming cedar glades. The shaly upper division of this group is of secondary importance.

In Jones' and the other anticlinal valleys the purer limestones of this age are commonly seen outcropping here and there in the lower places in smooth, rounded masses of a bluish color, rising very slightly above the general surface. Very little of the original growth is now standing in those parts of the valleys which have usually been long under cultivation. The soils are brownish sandy loams with yellowish subsoils. The slightly elevated knolls that vary the uniformity in these valleys have sandy soils, and are usually covered with short-leaf pine thickets of secondary growth. There are also spots of low, wet, boggy soil, not at all, however, like the flatwoods before described. The following analysis will show the composition of some soils of this kind:

No. 123. *Sandy brown-loam soil* (Trenton) from 3 miles west of Birmingham, Jefferson county. Depth, 10 inches; vegetation, red and willow oaks, sassafras, and grape-vines—little of the original growth to be seen; color, brown at top, passing into yellow at 3 inches depth.

Sandy brown-loam soil (Trenton limestone), Jefferson county.

	No. 123.	
Insoluble matter	85.990	90.331
Soluble silica	4.341	
Potash		0.176
Soda		0.028
Lime		0.152
Magnesia		0.116
Brown oxide of manganese		0.041
Peroxide of iron		2.840
Alumina		3.188
Phosphoric acid		0.066
Sulphuric acid		0.051
Water and organic matter		2.522
Total		99.511
Hygroscopic moisture absorbed at		7.835 24.4 C.°

This is a soil of only average fertility, and probably of little durability, but thrifty and easily tilled.

Clinton.—The rocks of this formation, calcareous sandstones and shales, with beds of red iron ore, yield sandy soils of considerable fertility, but their location on the steep hillsides makes them of little importance in agriculture. The red-ore ridges are in reality made up of three formations: the Clinton, the black shale, and the siliceous division of the sub-Carboniferous. The usual position of these ridges is on each side of the anticlinal valleys of the state, skirting the escarpments of Coal Measures, which form the borders of these valleys. In some places the ridges are duplicated on one side of the valley; but they are never wanting in the positions above indicated (except where ingulfed by a fault), though sometimes quite insignificant in height on one side.

In the western or anticlinal portion of the Coosa valley a red-ore ridge runs parallel with the eastern edge of Lookout mountain, and a similar ridge skirts the western edge of the Coosa coal-fields in the normal positions above mentioned; but in the eastern or faulted portion of the valley the red ridges are not associated with the Coal Measures, but form parts of synclinal basins holding the rocks of the sub-Carboniferous formation. The four localities thus far known of red-ore ridges in the eastern part of the valley are in the Dirtseller and the Gaylor mountains, in Cherokee county, in the mountain near Columbiana, in Shelby, and in the vicinity of Pratt's ferry, in Bibb county. The mountain near Columbiana has along its base a conglomerate which probably underlies the Red Mountain rocks proper and belongs to the Medina group. Where the red ridges are not too steep for cultivation their soils are well adapted to most of the southern crops, especially grain. The analysis which follows shows the average red mountain soil.

No. 68. *Red Mountain soil* (Clinton) from 3 miles north of Springville, Saint Clair county. Depth, 10 inches; vegetation, large poplars, white oaks, and chestnuts, with hickory, black gum, and red oak; color, chocolate-brown when cultivated.

Red Mountain (Clinton) soil, Saint Clair county.

	No. 68.	
Insoluble matter	81.560	85.240
Soluble silica	3.680	
Potash		0.206
Soda		0.037
Lime		0.363
Magnesia		0.279
Brown oxide of manganese		0.214
Peroxide of iron		4.918
Alumina		3.539
Phosphoric acid		0.168
Sulphuric acid		0.083
Water and organic matter		4.880
Total		99.877
Hygroscopic moisture		9.799
absorbed at		27.2 C.°

For the amount of insoluble matter this soil has a fair percentage of potash, a large percentage of phosphoric acid and lime, and is rather above the average in fertility, as might be inferred from the luxuriance of the forest growth which it supports. The Red Mountain soils are admirably suited to the production of small grain, but not for cotton, which is inclined to run to weed, at the expense of the fruit, unless restrained by superphosphates or other similar manures.

The above remarks apply to the red or brown soils only of these ridges, for it must be remembered that they have gray, flinty, gravelly soils usually on one side and the red soils on the other.

The black shale, which follows next after the Clinton, rarely, if ever, takes part in the formation of cultivated soils. It is, at best, only a few feet thick, and as it nearly always occurs in steep ridges it is of comparatively little importance agriculturally.

Sub-Carboniferous.—In the Coosa and outlying valleys of middle Alabama this formation, though occurring only in narrow belts, is of great importance, since it forms the basis of some of the most desirable farming lands in the region of its occurrence.

The surface distribution of the sub-Carboniferous strata is practically the same as that of the red-ore ridges, for, besides forming a part of the ridges themselves, they occupy the depressions between these ridges and the escarpment of the Coal Measures, and in the Coosa valley they form the surface in the four small synclinal basins mentioned in a preceding section. This formation, as a whole, has two well-marked divisions—the mountain limestone and the siliceous. The former, as its name implies, occurs along the sides of the mountains of the Coal Measures, and presents no tracts of arable land in this part of the state.

The lower group, which is generally known as the siliceous, is itself subdivided, and its two parts are very unequally concerned in the formation of tillable lands, for the lowermost or more siliceous division is, as we have seen, usually associated with the Clinton rocks in the formation of the red-ore ridges, which, because of their steep slopes, are not much in cultivation. The upper and more calcareous division of the siliceous group is the true soil-former of these belts. These soils are yellowish, reddish, and brown loams, similar to the soils of the red lands of northern Alabama, which are based upon the same rocks.

The principal discussion of this class of soils will be under the next division in northern Alabama, but the following analysis of a soil from Dry valley, in Cherokee county (basin of the Dirtseller), may serve to represent the composition of the soils of the narrow valleys of middle Alabama:

No. 111. *Red lands soil* (sub-Carboniferous), Dry valley, Cherokee county, 1 mile northeast of Gaylesville. Depth, 8 inches; vegetation, red, post, white, and Spanish oaks, hickory, persimmon, chestnut, black gum, sourwood, dogwood, and a second growth of short-leaf pine; color, reddish-brown.

Red lands soil, Cherokee county.

	No. 111.
Insoluble residue	78.725 } 84.767
Soluble silica	6.042 }
Potash	0.261
Soda	0.124
Lime	0.330
Magnesia	0.395
Brown oxide of manganese	0.215
Peroxide of iron	3.707
Alumina	5.077
Phosphoric acid	0.089
Sulphuric acid	0.097
Water and organic matter	5.150
Total	100.212
Humus	1.365
Available inorganic	1.081
Available phosphoric acid	0.029
Hygroscopic moisture	4.500
absorbed at	26.7 C.°

This soil is somewhat deficient in its retentiveness of moisture, as also in phosphoric acid; otherwise it is a very good soil. The high percentage of lime makes available its whole content of plant-food. The percentage of humus in this soil is also quite high, as well as the proportion of phosphoric acid immediately available.

A fuller exhibition of the characters and variations of these sub-Carboniferous brown loams will be seen under the heading of "The Tennessee Valley Region" (page 28), where they are widely distributed, and are of great importance agriculturally.

The Coosa and Cahaba coal-fields, although occurring in this division, are best described, together with the Coal Measures of the Warrior field, under the next division.

NORTHERN DIVISION.

This division, as already stated, adjoins the first or middle division on the northwest, and embraces most of the state lying north and west of a line drawn from Chattanooga, Tennessee, through Birmingham, nearly to Tuscaloosa. The area thus included is estimated at 9,700 square miles, and embraces the following counties and parts of counties: All of Lawrence, Winston, Walker, Cullman, Morgan, Limestone, and Madison, and parts of De Kalb, Cherokee, Etowah, Jackson, Marshall, Blount, Jefferson, Tuscaloosa, Fayette, Marion, Franklin, Colbert, and Lauderdale.

The two parts into which this division is, by its topographical and agricultural characters, naturally subdivided, are: 1. The continuation and terminus of the great Cumberland table-land, which in Alabama includes the Sand mountain and its outliers, Lookout and Blount mountains, on the south, and the detached spurs lying beyond the Tennessee on the north and the Warrior basin, into which the table-lands of Sand mountain gradually sink beyond the southwestern line of Blount county. 2. The great valley of the Tennessee.

The rock masses which in this division are concerned in the structure of the country and in the production of the soils are referred to two formations, the sub-Carboniferous and the Coal Measures. In some parts of this area the stratified drift overspreads the country rocks and forms the soils, but the drift belt, together with its outreaching marginal parts, which overlap other formations, will be treated as a whole under another head. The approximate horizontality of the strata, and the circumstance that the soils, almost without exception, have been derived from the immediately underlying rocks, have already been commented upon, and the close connection of the agricultural with the geological features has been pointed out. The two component parts of this division are most conveniently described separately.

COAL-MEASURES REGION.

COOSA AND CAHABA COAL-FIELDS.

The Coosa field embraces about 30 square miles in the northwestern part of Calhoun, about 150 square miles in Saint Clair, and about 235 square miles in Shelby county, making an aggregate of 415 square miles.

The Cahaba field includes about 50 square miles in Saint Clair, 100 in Jefferson, 160 in Shelby, and 125 in Bibb county, aggregating 435 square miles. Only 75 square miles in Bibb county are free from drift, so that the area depending upon the Coal Measures for its soil is reduced to 385 square miles.

In both these fields the strata, consisting of sandstones, conglomerates, shales, and coal beds, are tilted at considerable angles, and, possessing varying degrees of resistance of disintegration and erosion, have been very unequally degraded. The main ridges and valleys have the general direction of northeast and southwest, corresponding to the outcrops of the tilted strata; but this uniformity is often greatly obscured, and in places is obliterated by the irregularities produced by the streams which traverse the fields across the outcrops. In the presence of these inequalities, produced by the folding or the tilting of the strata, these fields differ from the great Warrior field, where the topographical features have no such direct connection with the geological structure. All the coal-fields have most of their characters in common; hence a further description of the topography, as well as of the agricultural features, can be well deferred till we come to speak of the Warrior field. It seems to be well established that the three coal-fields of Alabama were once continuous, and that they have been separated by folds (since denuded) and by faults.

THE WARRIOR FIELD.

That part of the Coal Measures of Alabama which is drained by both forks of the Warrior river and their tributaries has received the name of the Warrior coal-field. This field may be divided into two parts: the plateau or table-land, and the Warrior basin proper.

The table-land.—It is characteristic of the table-lands or plateaus that the limestone beds, which underlie the capping of Coal Measures rocks, are above the general drainage level of the country. This arrangement of the two classes of strata determines in great measure the character of the scenery, for the removal by erosion of the more perishable limestones causes the undermining of the harder sandstones above, which from time to time break off with vertical faces, forming cliffs. In height the plateaus diminish continuously toward the southwest, passing gradually into the Warrior basin. In the state of Tennessee their elevation above the surrounding country varies from 850 to 1,000 feet. In Jackson and Madison counties some of the spurs attain an equal height, but further southwest, in Morgan and Marshall, the elevation will not average more than 550, and in Cullman and Blount counties not more than 360 feet, and near the Mississippi line they come down to the drainage level. The main body of the table-land is known as Sand mountain, lying between the Sequatchie fold, or Brown's and Tennessee valleys, on the northwest, and Wills' and Murphree's valleys on the southeast, and include parts of De Kalb, Jackson, Marshall, and Blount counties. The highest parts of this table-land are to be found along its edges overlooking the valleys above mentioned, and there is a general slope both ways toward the center of the plateau, which thus becomes a shallow, elevated trough.

Beyond Wills' valley is Lookout mountain, an outlier of Sand mountain, and beyond Murphree's valley (southeast) Blount mountain, a spur of the main table-land. All these parts have similar structure, and their elevated rims, adjoining the valleys, are usually only slightly indented by the water-courses, except where some large stream leaves the plateau, as in the cases of Little river, on Lookout, and Short creek, on Sand mountain. Northwest of the Tennessee river, however, the tributaries of that stream have cut the elevated lands belonging to this division into a number of more or less isolated peaks, some of which, especially in the northeastern part of the state, have still the capping of Coal Measures, which have been entirely removed from many of those lying farthest toward the west. Overlooking the Tennessee valley, in Lawrence and Franklin counties, the elevated rim, which is locally called Sand mountain, is the border of the Warrior basin, and will be considered along with it.

Approximately, the area of the elevated lands or plateaus as above limited would be about 1,690 square miles on Sand mountain and its spur in Jackson, De Kalb, Marshall, Etowah, Morgan, Saint Clair, and Blount counties, about 290 square miles on Lookout mountain, in De Kalb, Cherokee, and Etowah, about 580 square miles in the detached spurs of the Cumberland northwest of the Tennessee, in Jackson, Madison, and Marshall, and to these might be added about half the area of Cullman county, whose measures partake of the characters of both the table-lands and of the basin, about 295 square miles; aggregating, in all, 2,855 square miles. A not inconsiderable part of this area north of the Tennessee is mountain slope, and is not strictly table-land.

The Warrior basin.—This, like the table-land, is in general a trough, shallow and sloping from northeast to southwest, with slightly elevated rims next to the Tennessee valley on the north and Jones' valley on the south. As Brown's valley divides the plateau, so its continuation southwestward as a ridge divides the basin into two unequal parts. Southwest of the confluence of the two Warriors these two parts seem to come together in one common basin by the sinking away of the ridge which separates them higher up.

The Warrior basin includes all of Walker and Winston and parts of Cullman, Morgan, Lawrence, Franklin, Marion, Lamar, Fayette, Tuscaloosa, and Jefferson counties, and will aggregate about 4,955 square miles. The whole

area of the Warrior field is thus estimated at about 7,810 square miles. (*a*) The surface of the elevated border lands here included is comparatively level, though sufficiently undulating, and in places the streams have cut deep gorges into the hard sandstones and conglomerates. In the basin there is much more inequality of surface, and in the vicinity of streams the country is often extremely rough, although the water-sheds are seldom more than 250 or 300 feet above the general level of the streams. Along the edges of both table-land and basin the higher rims are parts of folds of the strata, and are of sufficient height to determine the direction of the water-courses, and hence the nature of the topography. In the basin there are numerous undulations of the strata, but they are rarely of sufficient importance to affect the topography.

AGRICULTURAL FEATURES.—The Coal Measures present substantially the same characters everywhere as regards soils, but important variations result from differences in latitude and in elevation above the sea. The plateaus seem to be specially suited to the growth of fruits and vegetables and nutritious grasses; but since cotton is the southern crop *par excellence*, neither the plateaus nor the other parts of the coal-fields have hitherto been in good repute as farming lands. As yet, this part of the state is comparatively thinly settled, but its many advantages are gradually being appreciated.

In the discussion of the soil-varieties of the Warrior field reference is also made to those of the other coal-fields, as they are entirely similar. Since the soils of this region are derived from the disintegration of the country rocks, and as these are sandstones, shales, and conglomerates, the agricultural character of the coal-fields is easily understood. All the soils are sandy and more or less deficient in vegetable matter and lime. The subsoils vary from yellowish or reddish clay to sand. The better classes of these soils are light-colored loams, with yellowish or reddish subsoils, and are capable of improvement, since they well retain all fertilizers. The gray soils with light-colored to whitish subsoils, deficient in clayey matter, are too porous and droughty to be profitably cultivated, as they do not retain the fertilizers that may be applied to them.

In the order of their relative importance, both as to surface distribution and agricultural value, the cultivated soils of this region may be classed as follows:

1. *Sandy loams* of gray, yellowish to brown colors, forming perhaps three-fourths of the area. These soils vary between tolerably wide limits, and the natural growth is usually a mixture of various upland oaks, with some hickory and short-leaf pine. The analysis given (No. 110) may be taken as representing the average composition of soils of this class.

2. *Creek-bottom soils.*—These are, according to locality, sandy or loamy, and are generally in cultivation when the proportion of sand is not too great. The bottoms are usually narrow, especially when the surrounding country rocks are hard sandstones or conglomerates. The growth is of oaks, poplar (*Liriodendron*), beech, holly, and occasionally what is known as spruce pine. The more loamy bottom soils are underlaid with a reddish clay (hard), not mixing readily with the surface soil. The sandier varieties have a substratum of sand, and are not altogether so fertile as the preceding; both, however, produce well, are easy of tillage, and are generally under cultivation.

3. *Sandy soils.*—The most highly siliceous sandstones and conglomerates yield, on disintegration, a very sandy soil, which supports a growth of stunted black-jack oaks and short-leaf pines. Such soils are scarcely at all cultivated, and are of little importance agriculturally.

No. 110. *Upland soil*, Sand mountain, near Valley Head, De Kalb county. Depth, 20 inches; vegetation, chiefly red (Spanish) oak, some black oak, short-leaf pine, hickory, dogwood, and chestnut; color, light-gray as far as taken.

Sand Mountain soil (Coal Measures), De Kalb county.

	No. 110.	
Insoluble matter	86.350	90.702
Soluble silica	4.352	
Potash		0.230
Soda		0.141
Lime		0.068
Magnesia		0.154
Brown oxide of manganese		0.070
Peroxide of iron		1.443
Alumina		6.324
Phosphoric acid		0.078
Sulphuric acid		0.002
Water and organic matter		0.844
Total		100.111
Hygroscopic moisture absorbed at 16° C.		3.368

a Of the 4,955 square miles underlaid by the Coal Measures of the Warrior field, 1,990 are covered with drift deposits, so that only 2,965 of the whole area have soils which are derived from the sandstones, etc., of the Coal Measures. The proportion may be even smaller than this estimate makes it.

The yield of the fresh land at its best, without manures, is estimated at half a bale of cotton to the acre.

From the above analysis it will be seen that the soil contains a large proportion of sand and other siliceous matter (90.7 per cent.), and that there is a notable deficiency of lime and phosphoric acid, with a fair quantity of potash. The soils, therefore, of which this is a representative may be looked upon as rather below the average in fertility; but having usually a good basis of clayey matter they are susceptible of improvement. The agricultural history of this class of soils accords well with the teachings of the analysis, for until quite recently these lands have been almost totally neglected, being deemed comparatively worthless. Recently, however, the use of artificial fertilizers has become general, and it has been found that with a small outlay for phosphates or guano the best results are obtained. These soils are now generally considered the most reliable for cotton, though they are never cultivated without manures.

THE TENNESSEE VALLEY REGION.

Under this head are included not only the immediate valley of the Tennessee river, but also the whole region in Alabama drained by its tributaries, except the anticlinal valley, down which the river flows in Jackson county, and the table-lands of De Kalb, the Cumberland spurs in Jackson, Madison, and Marshall, already described, and the drift-belt in Franklin, Colbert, and Lauderdale counties. With these limits, therefore, this region will embrace an area on both sides of the Tennessee extending from the state line on the north to the Coal Measures of the Warrior field on the south. The average width of this drainage area from north to south is about 45 miles, and includes parts of Jackson, Marshall, Morgan, Lawrence, Franklin, Colbert, and Lauderdale, and all of Limestone and part of Madison counties, aggregating 4,530 square miles. (a)

The extreme western parts of Lauderdale, Colbert, and Franklin counties, while falling within the above limits, are best described in another connection, since the soils are derived from the surface beds of drift which there overlie the country rocks.

The general features of this region are those of a plain 12 to 15 miles wide, the Tennessee valley proper, through which the river flows in its tortuous path, the valley being bounded both on the north and on the south by hilly, and in some places almost mountainous, country, and the hills and the valley belonging to the same geological age, the configuration of the whole area being the result of erosion during long geological periods by waters whose present representatives are the Tennessee and its tributaries.

The average elevation of the summits, which represent approximately the general level of the original land surface, is in the eastern part of this region about 2,000 feet above the sea, and there is a gradual slope westward, so that the summits near the Mississippi line are not more than 900 or 1,000 feet above sea-level. The general surface of the lowlands exhibits a similar slope, the elevation at Huntsville being 612 feet, at Courtland 560 feet, and at Dickson 488 feet. The hilly country in the northern part of this area is known as the Barrens, and is a part of the great highland rim of Tennessee. These have generally light-colored siliceous soils, and are not much under cultivation, but they include many tracts with fertile calcareous soils.

South of the Barrens lies the valley proper of the Tennessee, which has usually a fertile calcareous soil of a deep red color. The surface is almost level, the uniformity broken here and there by slight elevations, generally covered with trees and made up of fragments of chert. Upon these wooded knolls are frequently situated the dwelling-houses of the planters. Throughout the whole area sink-holes and caves are common and almost characteristic.

The southern border of the valley is made by the escarpment of the Warrior coal-field, Sand mountain, as it is usually called, rising above the valley to a height which will average, perhaps, 600 or 700 feet. Along the northern face of this escarpment, about half way, is a terrace, or bench, which in the eastern part of Morgan county is very narrow, but widens going westward, and a considerable depression is formed between it and Sand mountain. In Lawrence and Franklin counties this depression is deepened into a valley with calcareous soils (Moulton and Russell's valleys), and the bench, now completely separated from Sand mountain, forms a very conspicuous feature of the landscape, known as the Little mountain range. These valleys have the same general characters as the Tennessee valley, and are partly based on the same rocks. The Little mountain range terminates toward the north with rather bold escarpments, but slopes more gently southward.

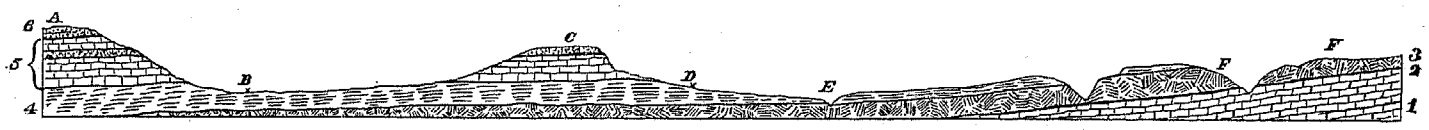
The three divisions of the Tennessee drainage area in northern Alabama are the Barrens, the valley lands, and the Little mountain range, and they divide the surface about as follows: Barrens, 910 square miles; valley lands, 2,430 square miles; and Little mountain range, 540 square miles.

GEOLOGICAL STRUCTURE.—Leaving out of consideration the mountain spurs of the Cumberland range in Jackson and Madison, the anticlinal fold of the Sequatchie in Jackson, and the drift in Lauderdale, Colbert, and Franklin, the surface rocks to which the soils of the Tennessee valley owe their origin belong to a single formation, the sub-Carboniferous, the subdivisions of which, as adopted by the state geological survey, are as follows: Upper: Calcareous—Mountain limestone, or Chester; lower: Siliceous—Saint Louis limestone and Keokuk.

a This represents approximately the whole area in northern Alabama underlaid by sub-Carboniferous strata. Of this, however, some 650 square miles in the western part of the valley are covered with drift, and hence are classed with the short-leaf pine uplands. This leaves 3,880 square miles, in which the soils are based on the sub-Carboniferous rocks.

In addition to the above, the strata of the Devonian and the Upper Silurian formations are exposed along certain creeks in the northern part of this region, but their superficial extent is small, and their part in the formation of the soils insignificant.

The following illustration, taken from the geological report for 1877-'78, and representing a section through the strata from the state line on the north, through Courtland and Moulton, to the Sand mountain on the south, will best illustrate the description below, and will make clear many of the circumstances affecting the distribution of the various agricultural features of the Tennessee valley:



SECTION ACROSS THE VALLEY OF THE TENNESSEE IN NORTHERN ALABAMA.

EXPLANATIONS.—1, Silurian; 2, Devonian; 3, Lower Siliceous; 4, Upper Siliceous; 5, Mountain limestone; 6, Coal Measures; A, Sand mountain; B, Moulton; C, Little mountains; D, Courtland; E, Tennessee river; F, Barrens. Scale.—Horizontal, 1 inch to 6 miles; vertical, 1 inch to 1,000 feet.

LITHOLOGICAL CHARACTERS, DISTRIBUTION, ETC.—1 *and* 2. *Silurian and Devonian.*—These two formations, which are composed of limestones and shales, are exposed only in the bluffs of streams which drain the northern part of this area, and which have their sources within the Tennessee line. The slight dip of the strata brings these beds within the reach of the denuding waters in the north, while farther south they pass below the overlying beds, as may be seen in the illustration. As stated, they are of no consequence from an agricultural standpoint, because of their very limited occurrence in Alabama, except along the borders of Elk river, in Limestone county, where they form some bodies of very good land.

3. *Lower Siliceous.*—These beds are supposed to be equivalent to the Keokuk and Burlington beds of other states and to the Barrens group of Tennessee. The most important rocks of the formation are highly siliceous limestone, alternating with a pure crystalline limestone, admirably suited to architectural purposes, and impure shaly limestones. The resistance to erosion offered by the flinty material with which a large proportion of the limestones are impregnated gives rise to the broken, rugged surface which characterizes so much of the Barrens. The whole thickness of the formation is about 300 feet, in which, 100 feet below, are the purer limestones, and 200 feet above are the more siliceous beds. The distribution of these beds as surface rocks is coextensive with that of the Barrens, as shown on the map.

4. *Upper Siliceous.*—This is the equivalent of the Saint Louis or coral limestone group, and is in many respects the most important of the formations occurring in northern Alabama, for from it are derived most of those soils which have made the valley of the Tennessee one of the best farming areas of the state. The rocks are, as a whole, cherty limestones, usually highly fossiliferous, and sometimes argillaceous. The chert of this division is generally easily recognized, being found in nodular masses filled with impressions of fossils. The country where this formation appears as surface rock is generally level, with low knobs, formed of fragments of chert, remnants of the cherty portions of the limestone. These chert masses are sometimes much decomposed, weathering occasionally to a white chalky-looking siliceous powder.

The soil over the Saint Louis limestone is usually colored deep red and orange by the hydrated oxide of iron with which it is impregnated, and this material is occasionally found in such quantity as to form regular ore banks (limonite). The limestones of this formation appear to have suffered subterranean erosion to a greater extent than those of any other, except, perhaps, the dolomite of the middle Alabama anticlinals. As a consequence, sink-holes, caves, underground streams, and big springs become almost characteristic of the Saint Louis group. The average thickness of the group in northern Alabama may be put at 150 feet, and its distribution as the surface rocks may be seen on the map, marked by the color of the red and valley lands, the greater part of which have been derived from it.

5. *Mountain limestone.*—This uppermost or calcareous member of the sub-Carboniferous formation, which is considered as an equivalent of the Chester group of other states, is composed of limestones and shales, with one bed of sandstone included. Its thickness in the eastern part of the valley, as for instance near Huntsville, is between 650 and 700 feet; but westward it thins down, being in Lawrence and Franklin counties seldom more than 150 or 200 feet. The characters of the rocks change also with the locality, for near Huntsville they are mostly limestones, the sandstone stratum being quite thin. In Lawrence, Colbert, and Franklin counties the limestones thin out, while the sandstone becomes prominent, having often a thickness of 75 feet. In these western counties also the sandstone bed is often duplicated, its two parts being separated by limestones.

The calcareous beds of the mountain limestone, as the name implies, are mostly found among the slopes of the Cumberland spurs in Jackson and Madison and along the slopes of the escarpment of Sand mountain in Morgan, Lawrence, and Franklin counties, and also along both the northern and southern slopes of the Little mountains in Morgan, Lawrence, Colbert, and Franklin. In addition to these localities, many of the valleys between the Cumberland spurs in Jackson and Madison and of the rich coves which indent the northern edge of the Sand mountain in Morgan, Lawrence, and Franklin counties are based upon these limestones. The sandstone bed, on

the other hand, is found as the surface rock of the terrace or bench which so generally occurs along the sides of the Sand mountain and of the Cumberland spurs, capping many of the smaller spurs in Jackson and Madison; and also at the summit of the Little mountains, which is only a remnant of this once wide terrace, now isolated from the main body by the cutting out of a valley between. Where the streams have cut through these mountains they flow generally through deep gorges or cañons with perpendicular sides, the sandstones forming the top rock, with the limestones below. The sandstone, being undermined by the wearing away of the underlying calcareous beds, breaks off, leaving perpendicular cliffs.

The character of the topography and the distribution of the mountain limestone beds will be easily inferred from the above remarks, and it is perhaps only necessary to state that some of the valleys and gaps separating the mountain spurs in the extreme east of this region are based, in part, upon the calcareous portions of this formation, which in such cases extend out to some distance from the base of the mountain.

AGRICULTURAL CHARACTERS.—*The Barrens.*—Based upon the rocks of the Lower Siliceous group, the Barrens occur in greatest force in the northern part of the state near the Tennessee line, in the counties of Madison, Limestone, and Lauderdale. In the valley, or red lands, occasional spots of barrens are exposed by the removal by denudation of the overlying rocks, and this is particularly the case in the vicinity of the Tennessee river itself, where the drainage has cut deepest. On the other hand, occasional spots of red lands may be found occupying the summits of the elevations in the Barrens, and thus, while the general line of separation of the two land varieties may be laid down with some accuracy, nothing short of extended exploration would enable one to mark out their precise limits. The whole area of the Barrens has been estimated at 910 square miles, of which 150 are in Madison, 400 in Limestone, and 360 in Lauderdale.

As a part of the highland rim of Tennessee, the Barrens may be described as a high plain, having an average elevation of perhaps 700 or 800 feet above the sea, with a general slope from the east toward the west and a special slope southward, caused by the drainage of the Tennessee river. The highest lands are in general near the state line on the north. Into this high land the streams have cut their channels, which, as a rule, are quite deep and narrow. Going southward, these indentations of the elevated plain become more numerous and widen out, the flat dividing lands narrow down, and near the larger streams become more or less rounded ridges, which are cut up by the smaller tributaries into a number of detached hills. These river hills, though often very steep, have good soils, and are generally in cultivation. Strips of the barren lands extend out into the valley lands along most of the larger streams, in some places coming down to the Tennessee itself. The western part of Lauderdale is perhaps the most broken of any of the barren lands in Alabama.

The two principal soil varieties of the Barrens are derived from the upper and lower rocks of the formation, respectively. The uppermost rocks are highly siliceous limestones, which form the surface over the greater part of this division and have given it its characteristic topographical and agricultural features, the lower beds, which are often pure limestones, being exposed chiefly in the larger creek valleys, and southward in the lowlands of the river. The disintegration of the siliceous rocks above named gives rise to the most widely distributed and characteristic class of Barrens soils, which are light-colored, whitish to gray sandy loams, having a reddish or yellowish siliceous subsoil, which, in turn, rests upon a hard-pan impervious to water at a depth of three to five feet. The Barrens land, like some of the Sand Mountain land already spoken of, was formerly considered almost worthless for farming purposes, but has been coming rapidly into favor of late years. It has been found that by the use of, say, 200 pounds of guano to the acre this land gives a fine yield of cotton. The main difficulty with cotton is in keeping a stand of the young plants in the early spring, as on account of the impervious hard-pan underlying the subsoil the land is often badly drained and the young plants are "scalded", and thus killed. A drain of less than four feet depth is generally useless. The subjoined analyses will show the general character of the Barrens soil:

No. 40. *Barrens soil* from near Cluttsville, Madison county, collected by Thomas B. Kelly. Depth, 8 inches; vegetation, post, black, red, Spanish, and black-jack oaks, scrub hickory, wild gooseberry, blackberry, winter huckleberry, and a coarse grass, good for sheep and cattle; color, yellowish-gray. This soil is easily cultivated, and, when properly drained, produces well. It was formerly timbered with chestnuts, since disappeared. After rains the soil hardens, thus preventing the growth of cotton till broken up with a plow.

No. 48. *Barrens soil* from near Huntsville, Madison county, collected by Colonel W. C. Irwin. Depth, 6 inches; vegetation, scrubby post and black oaks, a few hickories and dogwoods; no grass, but a thick undergrowth of dogwood bushes; color, light yellowish-gray; change of tint at 3½ inches, clay at 7 inches.

Barrens soils (sub-Carboniferous), Madison county.

	Cluttsville soil.	Huntsville soil.
	No. 40.	No. 48.
Insoluble matter	89.950	84.160
Soluble silica	2.292	4.560
	92.242	88.720
Potash	0.255	0.116
Soda	0.064	0.025
Lime	0.064	0.041
Magnesia	0.035	0.159
Brown oxide of manganese	0.150	0.041
Peroxide of iron	1.695	2.705
Alumina	3.292	4.597
Phosphoric acid	0.100	0.054
Sulphuric acid	0.178	0.045
Water and organic matter	2.024	3.388
Total	100.099	99.891
Hygroscopic moisture	4.450	4.785
absorbed at	21 C.°	28 C.°

These analyses show a large percentage of insoluble matter and a deficiency of lime and vegetable matter. The hardening of No. 40 is probably due to this lack of organic matter. In potash and phosphoric acid, considering the amount of insoluble matter, there is a sufficiency in the case of No. 40. Neither soil has much capacity for retaining moisture. These soils, like those of the Coal Measures, chemically somewhat similar, have generally a good foundation of clay, and are therefore capable of improvement.

Within the limits of the Barrens there is a class of soils making what are called the gravelly bottom lands. These are gravelly loams of gray to yellow or brown colors, resting on somewhat heavier, yellowish-red subsoil. The river hills along the Tennessee in some localities are apparently of a somewhat similar nature.

No. 52. *Gravelly soil*, Limestone creek bottom, near Cluttsville, Madison county, collected by Thomas B. Kelly. Depth, not given; vegetation, poplar, beech, sugar-maple, sycamore, gum, walnut, red, white, and black oaks; color, light-brown; a somewhat difficult soil to till because of the gravel.

No. 56. *Gravelly or river-hills soil*, one-fourth of a mile south of the Tennessee river, near Tuscumbia, Colbert county, collected by B. Pybas. Depth, 4½ inches; vegetation, red, white, and black-jack oaks, dogwood, white poplar, and small scrub-walnut; color, gray with shade of yellow; subsoil, dark ocher, reaching to 2 feet depth.

Gravelly-bottom and river-hills soils, Barrens (sub-Carboniferous).

	MADISON COUNTY.	COLBERT COUNTY.
	Limestone creek bottom.	Tennessee river hills.
	No. 52.	No. 56.
Insoluble matter	79.005	79.320
Soluble silica	6.023	6.760
	85.028	86.080
Potash	0.270	0.309
Soda	0.161	0.067
Lime	0.182	0.308
Magnesia	0.224	0.226
Brown oxide of manganese	0.290	0.324
Peroxide of iron	2.871	2.969
Alumina	4.834	4.771
Phosphoric acid	0.209	0.153
Sulphuric acid	0.010	0.172
Water and organic matter	5.758	4.458
Total	99.786	99.927
Humus	1.974	.....
Available inorganic	0.860	.....
Available phosphoric acid	0.073	.....
Hygroscopic moisture	6.881	5.371
absorbed at	9.4 C.°	28.3 C.°

These analyses indicate soils of a fair degree of fertility and durability, which, while they contain a large proportion of insoluble matter, are yet thrifty, by reason of a comparatively large percentage of lime and magnesia. In productiveness they stand much nearer the red lands than the Barrens, the average seed-cotton product per acre being given at from 800 to 1,200 pounds, while that of the Barrens will probably not average more than from 500 to 700 pounds. Perhaps less than 10 per cent. of the cultivated land of the immediate valley of the Tennessee is of this kind.

To recapitulate, until quite recently the great proportion of cultivated lands of the valley of the Tennessee were red limestone lands. Of late, however, the lighter and more siliceous soils of the Barrens have been found to be profitable soils to cultivate, especially with artificial fertilizers, and these are now preferred by many, as they are safer and easier of cultivation. The cotton staple from these lands is less likely to be stained or otherwise injured than that from the red lands.

The limestones which make the lower part of the formation yield a red or brown-loam soil, and is in most respects similar to that of the red lands of the valley. Of this no analyses have been made. This soil is confined to the borders of the streams which traverse the highlands, and, while of much better quality than the average soil of the Barrens, is of limited occurrence.

The red or valley lands.—Under this head are included the valley proper of the Tennessee, extending from the Barrens on the north to the Little mountains on the south, the valley lying between the Little mountain range and Sand mountain, and the valleys and gaps separating the spurs of the Cumberland in the eastern part of this division, which are all closely related in their agricultural and topographical features. The area is estimated at about 2,430 square miles, of which 320 are in Jackson, 460 in Madison, 190 in Limestone, 240 in Lauderdale, 210 in Franklin, 150 in Colbert, 480 in Lawrence, 285 in Morgan, and 95 in Marshall counties. In this estimate are included also those calcareous lands derived from the limestones of the mountain limestone formation where they occur in the valleys and not upon the mountain slopes.

The general character of the valley lands has already been alluded to. They are nearly level or gently undulating, especially near the Tennessee river, on both sides; but in the gaps between the mountain spurs the surface is more broken. On account of the fertile nature of the soil most of these lands are cleared and under cultivation, but the monotony is agreeably relieved by the low knolls, which are covered with a luxuriant growth of oaks. These knolls are formed by the accumulation of the siliceous parts of the limestone, and, being too rocky for easy cultivation, are often chosen as sites for the dwelling-houses of the planters. Where the flaggy limestones, either of the Saint Louis or of the mountain limestone group, lie very near the surface, with but a thin coating of soil, they are usually covered with a dense thicket or glade of red cedar. Sink-holes and big springs are numerous throughout the valley.

The Saint Louis or coral limestone has been described as a siliceous limestone, and in its disintegration it yields a soil which, while varying between wide limits, is in general terms a sandy loam, resting upon what is usually called red clay, but which is a heavy loam, containing from 2 to 8 per cent. of ferric oxide and about an equal proportion of alumina. The soil varies in color from mulatto to deep-red and nearly black, according to the proportions of the several ingredients. The following analyses of soils of this character from different localities will show well the variations in the quality, as well as the average composition of these lands:

No. 38. *Red lands soil* from near Cluttsville, Madison county, collected by Thomas B. Kelly. Depth, 11 inches; vegetation, hickory, poplar, ash, red, black, and white oaks, chestnut, walnut, elm, cedar, black haw, dogwood, etc.; color of the soil, dark-brown; of the subsoil, yellowish-brown. In its physical properties this soil is very friable. Water sinks rapidly into it, and is retained by the subsoil.

No. 34. *Red lands soil* from 1 mile east of Tuscumbia, Colbert county, collected by B. Pybas. Depth, 10 inches; vegetation, black-jack, red, and post oaks, hickory, and scrub cedar; no undergrowth; color, dark-brown to nearly black. This soil after rains tends to form a crust, which, if not broken up, becomes nearly as hard as a rock.

No. 64. *Red lands soil* from Russell's valley, near Russellville, Franklin county, collected by Dr. Daniel Sevier. Depth, 15 inches; vegetation, red, black, white, post, and black-jack oaks, cedar, dogwood, chestnut, walnut, wild cherry, and black locust; color, dark-brown, passing to a lighter reddish-brown in the subsoil.

Red soils, Tennessee valley (sub-Carboniferous).

	Madison County.	Colbert County.	Franklin County.
	Cluttsville.	Tuscumbia.	Russellville.
	Red lands soil.	Red lands soil.	Red lands soil.
	No. 38.	No. 34.	No. 64.
Insoluble matter	77.950	76.023	75.360
Soluble silica	5.343 } 83.293	8.995 } 85.018	5.237 } 80.597
Potash	0.243	0.276	0.154
Soda	0.058	0.133	0.110
Lime	0.648	0.267	0.250
Magnesia	0.058	0.381	0.250
Brown oxide of manganese	0.103	0.218	0.138
Peroxide of iron	2.873	5.230	5.623
Alumina	6.198	5.691	8.163
Phosphoric acid	0.188	0.151	0.220
Sulphuric acid	0.025	0.020	0.089
Water and organic matter	6.620	1.794	4.100
Total	100.307	99.179	99.653
Humus	2.242	0.700	.....
Available inorganic	1.551	0.956	.....
Available phosphoric acid	0.109	0.020	.....
Hygroscopic moisture	9.760	8.340	0.14
absorbed at	21 C.°	7.8 C.°	26.7 C.°

Since the immediate fertility of a soil depends upon the available phosphoric acid and other inorganic plant-food, the humus determinations should give us an insight into the capabilities of a soil with reference to the next succeeding crop.

The analyses show that all these soils are of rather more than average fertility; and while they do not contain unusually large amounts of phosphoric acid and potash, yet the large percentage of lime in each case renders the soil thrifty. In comparing No. 38 with No. 34 the latter is seen to be notably deficient in vegetable matter, to which may probably be ascribed its tendency to bake hard after rains. In the percentage of humus, also, they differ widely, as also in the amount of available phosphoric acid, which in No. 38 is 0.109, and in No. 34 only 0.020 per cent. All three soils have fair capacity for retaining moisture.

The creek-bottom lands in the Tennessee valley are of varying degrees of fertility, but are generally productive, since they contain the best parts of the uplands which surround them.

Upon the sides of the mountain spurs in Jackson, Madison, Marshall, and Morgan counties, and also along the base of the Little mountain range, the calcareous parts of the mountain limestone yield a stiff clayey and limy soil, which supports a fine growth of forest trees, but which, on account of their position on the mountain slopes, are not well suited to cultivation. But there are many places in the counties named where this soil is found in sufficiently level position to be profitably cultivated, and in many of the rich coves which penetrate the edges of the mountains these are the prevailing soils. No analyses have been made, but the crops produced show that they are in character somewhat like the red valley soils, though not so generally of red colors. The prevailing color is gray to black, and there are spots of black soil that recall in appearance the black prairie soils of the south, to be found in places on Little mountains and other localities made by this formation.

The Little mountains.—This well-marked feature of the Tennessee valley has already been alluded to and its principal characters given. The Little mountains proper extend from Morgan, through Lawrence and Colbert counties, out to the Mississippi line. In Madison and Jackson counties there are many small and detached spurs which have exactly similar structure to that of the main body, and they are to be considered in the same connection. All these spurs, and the Little mountains themselves, owe their existence to a stratum of sandstone in the mountain limestone or Chester group, which has protected them against the erosion that has wasted away the adjacent lands on all sides. From the approximately horizontal position of the strata the summits of these mountains are mostly rather level, though worn into slight depressions here and there. As a general thing these lands are not much under cultivation, since the soil derived from the sandstones is not rich, and scarcely pays to cultivate.

The northern face of these mountains is usually steep and abrupt and somewhat indented with fertile coves having red and brown-loam soils. The southern slope is much more gradual. Where the sandstone has been removed the underlying calcareous rocks of the formation come to the surface and give rise to the so-called prairies, which are destitute of trees, because of the thinness of the soil and the proximity of the rock to the surface. Such

places furnish, however, excellent pasturage. The prairie spots are generally found on the summit or southern slope of these mountains, but along their northern or steep face there is very often seen a level bench, or terrace, with the stiff, limy soils of this character.

On account of their elevation and pleasant climate the Little mountains are favorite places of residence, and several towns are situated upon them, among which may be mentioned Somerville, Mountain Home, La Grange, etc. Where streams have cut across the Little mountains they flow through deep gorges with almost perpendicular sides, and underneath some of the sandstone ledges often spring chalybeate and other mineral waters. The area occupied by the Little mountains and similar elevations is estimated to be about 540 square miles, of which 50 are found in the detached spurs of Madison county, 140 in Morgan, 150 in Lawrence, 170 in Colbert, and 30 in Franklin.

Soils.—The agricultural features of the mountain spurs here included are, as might be supposed, rather uniform. The sandstone, which forms the greater part of the surface, yields a sandy soil, which is closely like the prevailing soil in the Coal Measures. Its chief timber also resembles that of the coal regions, consisting of Spanish, post, and white oaks, with some short-leaf pine. Other trees are common in some places, as chestnuts and hickories.

The following analysis of a soil collected on Little mountains near the old town of La Grange, in Colbert county, will serve to show the general nature of these lands:

No. 36. *Little Mountain soil* from La Grange, near Tuscumbia, in Colbert county, collected by B. Pybas. Depth, 8 inches; vegetation, chestnut, short-leaf pine, hickory, post oak, and small sourwood; color, top soil dark brown 2 inches; below that yellowish sand at 2 feet, and at 5 feet solid sandstone rock.

Sandy soil of Little mountains, Colbert county.

	No. 36.	
Insoluble matter	93.630	95.312
Soluble silica	1.682	
Potash		0.100
Soda		0.060
Lime		0.120
Magnesia		0.040
Brown oxide of manganese		0.102
Peroxide of iron		0.761
Alumina		1.532
Phosphoric acid		0.051
Sulphuric acid		0.028
Water and organic matter		2.055
Total		100.161
Hygroscopic moisture absorbed at		1.56 25.6 C.°

A rather poor soil, like that of the Coal Measures generally, but with a larger proportion of lime and of organic matter and less of potash.

SOUTHERN DIVISION.

All that part of the state south and west of the limits of the middle and northern divisions is embraced in the southern division, which includes the whole or parts of Lauderdale, Colbert, Franklin, Marion, Lamar, Fayette, Tuscaloosa, Bibb, Chilton, Elmore, Tallapoosa, and Lee counties, and all of Pickens, Greene, Hale, Sumter, Choctaw, Marengo, Dallas, Perry, Autauga, Lowndes, Montgomery, Macon, Bullock, Russell, Barbour, Pike, Crenshaw, Butler, Wilcox, Monroe, Clarke, Washington, Mobile, Baldwin, Escambia, Conecuh, Covington, Geneva, Coffee, Dale, and Henry. The area of this division is approximately 32,335 square miles.

GENERAL GEOLOGICAL AND TOPOGRAPHICAL FEATURES AND SUBDIVISIONS.—The Cretaceous and Tertiary rocks which underlie this whole division are approximately horizontal in stratification, but have a slight dip toward the south and southwest. With the exception of part of the prairies, presently to be described, the whole area is covered with beds of drifted material which have been deposited upon an eroded surface of the older rocks. The drift-beds are, as a rule, very irregularly stratified.

It may thus be inferred that the minor details of surface configuration and the soils are, to a certain extent, independent of the underlying older rocks, and are in great measure determined by these drifted materials. In these respects this division differs from the two preceding ones. But while it depends to so great an extent for its soils and topography upon a single formation, there is not in these the great monotony that might be

looked for on this account. The drift itself is composed of materials which offer varying degrees of resistance to denudation, and considerable inequalities of surface result from this circumstance. In addition to this, the older rocks had been greatly eroded before they were covered by the drift, so that the general contour of the country, as well as many of the most prominent topographical features in this division, are quite independent of the superficial drift-coating which determines so many of the minor details.

The low trough of the prairie region, the rugged hills of the buhr-stone, and the gently undulating surface of the southern pine belt were features of the landscape before the deposition of the drift; and similarly with the soils the drift itself yields a number of varieties, which are still further increased by the modifications brought about by their intermixture with the disintegrated portions of the underlying country rocks. These rocks are referred to two principal formations, the Cretaceous and the Tertiary. For convenience of reference I give in condensed form the most important subdivisions of these formations, together with their lithological and other characters in so far as they are of importance in determining the agricultural features.

TERTIARY.—*Vicksburg* (uppermost).—The chief material is a soft white limestone (containing *Orbitoides Mantelli*), easily cut with an ax or a saw into blocks, which are used throughout the region of its occurrence in the construction of chimneys. This alternates with whitish shell marls, and occurs over a belt of country from 30 to 50 miles wide north and south, the lower half of which is gently undulating, the upper somewhat broken and hilly. The whole region is covered with beds of later age, which, in most cases, form the soils.

Jackson.—An impure limestone or calcareous clay of a light, nearly white color, containing grains of greensand, is the chief material of this formation in Alabama. Its thickness is from 40 to 50 feet, and in some places it is underlaid with fossiliferous sands and with ten feet or more of grayish laminated clays. The disintegration of the principal stratum gives rise to the calcareous prairie soils of the lime-hills, whose surface distribution is the same as that of the northern half of the Vicksburg. Like the preceding, the strata of this group are generally covered with beds of a more recent formation, which form the greater part of the soils, and in great measure determine the topography; yet where these overlying beds have been partially removed the characteristic soils and no less characteristic topography of the lime-hills are produced.

Claiborne.—The materials of this division consist of sandy shell deposits, alternating with impure whitish limestones or calcareous clays containing greensand. These deposits are exposed along ravines and bluffs, but seldom form the surface over any considerable area, and have comparatively little effect upon the soils beyond making them locally more fertile. These beds may be observed at the lower levels throughout the territory above assigned to the Jackson group.

Buhr-stone.—Siliceous sandstones and claystones make up the greater part of this division. These deposits form a line of rocky hills extending nearly across the state. In general, the soils are extremely poor; but there are limited areas of more fertile character, due to the influence of the calcareous beds, with which the prevailing materials are sparingly interstratified.

Lagrange or Lignitic.—Grayish or dark-colored laminated clays and yellowish or gray sands, containing several beds of lignite and alternating with beds of greensand marl. These materials form the substratum of a belt 15 or 20 miles in width, the soils of which are mostly derived from the superficial beds of drift, except where the marl beds, especially along the southern border of this division, give rise to highly fertile lime-hills, closely resembling those of the Jackson group.

Flatwoods.—The chief strata are "massy" or thick-bedded joint-clays of gray or darker colors, and of tolerably uniform character. The soils are heavy and clayey, seldom tempered to any considerable degree by the sandy beds of the drift. The timber is mostly post oak.

CRETACEOUS.—*Ripley.*—Hard crystalline and often sandy limestone and bluish, micaceous, frequently highly fossiliferous marls make up the greater part of this division. The blue marl has its best development in the eastern part of the state. The interstratification of the hard limestone with the softer marls gives rise to the rugged topography of the hill prairie region. The larger proportion of the soils over this division are derived from the drift, with local modifications due to the influence of the marls and limestone, while occasionally the soils are derived almost wholly from the Cretaceous material.

Rotten limestone.—An impure argillaceous limestone of great uniformity of composition over wide areas is the characteristic material of this division. The surface is gently undulating, and the soils are derived partly from the simple disintegration of the limestone and partly from admixtures of this with the loam of the drift. This rock underlies a belt of country averaging 15 or 20 miles in width, and is noted for its fertility.

Eutaw.—The chief materials of the Eutaw group are gray laminated clays, irregularly bedded sands, containing some mica, and having often a greenish cast, partly from grains of greensand and partly from some substance coating the siliceous sand grains.

Subordinated to the above are beds of lignite and lignitized trunks of trees. The soils over the whole area are derived from the overlying drift, except along the sides of ravines, etc., where the above-named materials are uncovered, giving rise to small tracts of more than average fertility, which lie, however, usually on such steep slopes as to be of little agricultural value. The stratigraphical relations of these formations are shown in sufficient detail in the general section given on page 13.

Taken as a whole, the surface of the southern division has a general slope from the margin of the two divisions just described outward, *i. e.*, west and south toward the Mississippi basin and the Gulf of Mexico. This general slope is interrupted by the trough of the central prairie region, which is depressed many feet below the general level both north and south of it, and also on a limited scale by the trough of the flatwoods. South of the prairie belt there is a line of rocky hills made by the hard sandstones and claystones of the lower part of the Tertiary formation, beyond which, toward the south, the country falls away very gradually and uniformly to the coast.

Mention has been made of the differences existing in the materials of the drift formation overlying the most of this region. These materials are pebbles, sands, and a red, brown, or yellow loam, and the geographical distribution of these several materials, taken in connection with other physical conditions, lies at the basis of the classification of this division into its agricultural regions.

Around the outer margin of the two preceding divisions there is seen a great accumulation of these drift beds, so great as to hide completely from view over areas of considerable size all the underlying rocks of the country. Along this belt pebbles of quartz and chert and beds of red and brown loam are seen in their greatest thickness. As we go outward from this belt the pebbles become less and less abundant, and seem to be confined to well-defined channels, along which, however, they may be traced for great distances, even into Florida, but they cease to be characteristic beyond a comparatively narrow belt. The loam also appears to decrease in thickness and prominence in the same directions, though it is found generally distributed much farther south than the pebbles.

The whole region over which the red and brown loams prevail has many topographical and botanical features in common, prominent among which are the broken and hilly surface and the mixture with pines of oak and hickory in the forest growth. Southward from this region of mixed growth the long-leaf pine is the most characteristic and constantly occurring tree, and gives the name to a second region, which reaches to the Gulf of Mexico.

The subdivisions of the region of mixed growth are based primarily upon the species of pine which is associated with the other trees, it being the short-leaf pine in the one case and the long-leaf in the other. Other subdivisions of this region depend on the relative proportions of long-leaf pine and other timber trees.

The region of the long-leaf pine is subdivided, in accordance with the prevailing topographical character, into hilly, rolling, and flat lands.

The black-prairie region, the flatwoods, and the lime-hills are agricultural regions, in which the soils are to a great extent dependent on the rocks of the country for their formation, and do not properly find a place in the two regions as just defined.

In accordance with the characters given, the southern division may be divided into the following agricultural regions or subdivisions:

1. *The Oak and Pine Uplands Region*, including—
   - The oak and hickory and short-leaf pine uplands.
   - The gravelly hills, with long-leaf pine.
   - The oak and hickory uplands, with long-leaf pine, including brown-loam uplands and long-leaf pine uplands.
2. *The Central or Upper Prairie Region*, with its three features of—
   - Black prairie or "canebrake".
   - Hill prairie or Chunnenugga ridge.
   - The blue marl lands.
3. *The Post-oak Flatwoods.*
4. *The Lower Prairie or Lime-Hills Region*, including the shell prairies and red-lime lands.
5. *The Long-leaf Pine Region*, with its subdivisions—
   - Long-leaf pine hills.
   - Rolling, open pine woods and lime-sink region.
   - Pine flats.
6. *The Alluvial Region of Mobile River and the coast marshes.*

From the nature of the forest growth, as outlined in the above agricultural subdivisions, it may be inferred that the prevailing soil varies with the geographical position, and in fact we find that the surface soil increases in sandiness as we go southward toward the Gulf. In addition to this, local variations in the predominant soil of all the regions just enumerated arise from the varying quality at different depths of these superficial beds of loam and drift. To illustrate this a series of specimens was taken near the city of Tuscaloosa down to the depth of 14 feet, passing through the red loam and into the underlying sand and pebble beds.

No. 115. *Soil*, brownish-red color, taken to the depth of 5 inches.

No. 116. *Subsoil*, clayey loam, of a deep-red color, taken from 5 to 18 inches.

No. 117. *Under subsoil*, more sandy, and of same deep-red color, taken from 18 inches to 3½ feet.

No. 118. *Red, sandy loam*, taken from 3½ to 7½ feet.

No. 119. *Reddish sandy loam*, increasing in sandiness with the depth, and becoming yellowish in color; taken from 7½ to 9½ feet.

No. 120. *Yellowish, coarse sand*, taken from 9½ to 14 feet. The preceding bed gradually passes into this.

No. 121 is *a bed of pebbles with sand*, irregularly stratified, and of variable thickness and quality, extending to the bottom of the gully, say from 14 to 45 feet. This has not yet been analyzed.

No. 122. *Gray clay, with a few specks of red.* This was an irregularly-shaped bed near the bottom of the section.

These specimens were analyzed by Mr. D. W. Langdon, jr., of Mobile, a student in my laboratory, with results as given below:

Analyses of brown-loam soil, with subsoil, and the underlying beds, down to the depth of 14 *feet; also, analysis of gray clay, Tuscaloosa.*

	Soil brownish-red to depth of 5 inches.	Subsoil deep-red from 5 to 18 inches.	Under subsoil deep-red 18 inches to 3½ feet.	Red, sandy loam, more yellowish than preceding, 3½ to 7½ feet.	Red, sandy loam, becoming yellowish below, 7½ to 9½ feet.	Yellowish, coarse sand, 9½ to 14 feet.	Gray clay, with a few specks of red, bottom of gully.
	No. 115.	No. 116.	No. 117.	No. 118.	No. 119.	No. 120.	No. 122.
Insoluble matter	81.683	84.777	91.493	88.989	96.405	98.370	81.837
Soluble silica	0.465	0.656	0.066	1.827	0.687	0.086	0.256
	82.148	85.433	91.559	90.816	97.092	98.456	82.093
Potash	0.255	0.205	0.150	0.139	0.005	0.005	0.256
Soda	0.175	0.175	0.140	0.135	0.004	0.003	0.197
Lime	0.140	0.065	0.071	0.045	0.006	0.004	0.341
Magnesia	0.097	0.100	0.005	0.004	0.002	0.001	0.194
Brown oxide of manganese	0.102	0.099	0.066	0.061	0.003	0.002	0.010
Peroxide of iron	4.184	4.903	2.495	2.592	1.910	0.717	0.576
Alumina	7.081	6.278	3.466	3.998	0.786	0.454	11.314
Phosphoric acid	0.090	0.086	0.007	0.007	0.003	0.001	0.001
Sulphuric acid	0.025	0.083	0.071	0.066	0.004	0.004	0.150
Water and organic matter	5.425	2.288	1.987	1.791	0.841	0.752	5.140
Total	99.722	99.715	100.017	99.654	100.656	100.399	100.272
Hygroscopic moisture absorbed at	6.305 18 C.°	7.275 18 C.°	5.647 19 C.°	4.103 18 C.°	3.996 18 C.°	0.290 10 C.°	....

These analyses show very clearly the gradual decrease in the percentages of potash, lime, magnesia, and phosphoric acid, and consequent deterioration of the soil-forming qualities of the beds as the depth from the surface increases, and a similar decrease in the capacity for moisture in the same direction. The prominent points of difference between the loam and the drift sands are best seen on comparing Nos. 118 and 120, since No. 119 forms a transition between the two. This transition bed (No. 119) shows how the lower parts of the loam and the upper parts of the underlying drift shade off into each other without there being any sharp line between, and yet within 2 feet the change from loam to sand is complete.

From the analyses we can also easily account for the fact, so often to be observed in the parts of the state where these beds make the surface, that along many of the slopes of the loam-covered table-lands we find a forest growth entirely different from that of the plains above and denoting a great deterioration in the quality of the soil. A removal by denudation of the loam will expose the greatly inferior sands and cause a corresponding change in the character of the soil. Many of the poor pine ridges which traverse the areas of better land have had this surface loam in great measure removed. On the other hand, the sandiness of the soils of some of the table-lands finds its explanation in the fact that on such level lands the surface materials are not washed off bodily, but the finer clayey particles are carried by the percolating water deeper from the surface, leaving the coarser sand above. In most cases of this kind the surface soil is usually much more sandy than its subsoil.

The specimens of which the analyses are given were taken from a slope where both the finer clayey and the coarser sandy particles of the loam would be washed away together by the rains, thus preserving at the surface nearly the original proportions between the two.

In the following detailed descriptions of the agricultural regions of this southern part of the state these general principles will find many applications.

THE OAK AND PINE UPLANDS REGION.

This region, with its subdivisions, embraces an area of 16,915 square miles, and includes some of the best uplands of the state. Its two principal subdivisions, as already stated, are named from the species of pine which characterize them. As far north as about latitude 33° 30′ the long-leaf pine is prevalent; farther north it is the short-leaf species. The northern and eastern margins of this region (lying next to the preceding general divisions) are well characterized by the accumulation of flinty pebbles.

The soils along this gravelly belt are not materially different from those of the other parts of the oak and pine

uplands, except that they are, in general, rather poorer and more sandy; but since a line of gravelly hills, timbered with oaks and long-leaf pine, runs along the border of the metamorphic or crystalline rocks through South Carolina and Georgia into Alabama with substantially the same characters, this division is here retained.

OAK AND HICKORY UPLANDS, WITH SHORT-LEAF PINE.

This region includes the whole or parts of Lauderdale, Colbert, Marion, Lamar, Fayette, Tuscaloosa, and Pickens counties, with an area of about 4,135 square miles. In its soils and topography it is so closely connected with the next two regions that a special account of the same would involve much repetition. Along the eastern margin of this region there are some modifications of the soils, brought about by the influence of the underlying rocks, which in the three first-named counties belong to the sub-Carboniferous formation, and in the others to the Coal Measures. These, however, have not been specially studied, and the larger proportion of the soils may be referred to the red loam, which also in great measure makes the surface of the following regions. Most of the soil varieties occurring in the region next to be described have their representatives here, and the analyses there given will show their general characters in this section also.

GRAVELLY PINE HILLS, WITH LONG-LEAF PINE.

This subdivision occupies a belt of varying width, but averaging perhaps 30 miles, bordering on the south and west the older formations of the state (Metamorphic, Silurian, and Carboniferous), and hiding the line of contact between these and the Cretaceous formation. This belt stretches from Lauderdale county, on the northwest, to Russell county, on the east, and includes the following counties and parts of counties: The western parts of Lauderdale, Colbert, Franklin, Marion, Lamar, and Fayette; nearly all of Pickens, Tuscaloosa, and Bibb; northern Greene, Hale, Perry, and Dallas, southern Chilton, nearly all of Autauga, southern Elmore, and Tallapoosa; northern Montgomery, most of Macon and Russell, and southern Lee.

Within these limits there are about 6,170 square miles in which the drift beds conceal completely the underlying rocks and 2,650 square miles in which these surface beds make the greater part of the soils and the older rocks show only along the water-courses. The whole area in which the gravelly hills with short-leaf and long-leaf pines characterize the country may thus be placed at about 8,820 square miles. But since these gravelly hills with short-leaf pine timber in the northwestern part of the state present no very clearly marked points of difference from the short-leaf pine uplands of Mississippi, into which they gradually pass, it is only that portion of the gravelly hills with long-leaf pine that is to be considered under this head. With these limitations, therefore, this region embraces parts of the counties of Tuscaloosa, Pickens, Greene, Hale, Bibb, Perry, Dallas, Chilton, Autauga, Elmore, Montgomery, Tallapoosa, Macon, Lee, and Russell, with an area which has been estimated at 4,685 square miles.

GENERAL CHARACTERS.—As the name indicates, this subdivision has a rather uneven, hilly surface, especially where the table-lands break off toward the water-courses. Between these there are often tolerably wide tracts of nearly level land. The hills are, in general, clothed with a growth of upland oaks, among which the pines are usually conspicuous.

The surface over most of this territory is formed of beds of red or yellowish loam varying in thickness from a few inches to 25 feet. This loam is, in general, devoid of lines of stratification, and overlies beds of sand and pebbles, which are very distinctly stratified, although the stratification is extremely irregular. All these beds rest upon a worn or eroded surface of the older rocks, and on this account the thickness varies considerably. In many parts of the region the sands and pebbles have been cemented together into pretty solid rocks by the iron which is so generally present as coloring matter. These are the only hard rocks belonging to the surface beds. In some parts of the more northern counties, and in Tuscaloosa, these pebbly conglomerates act an important part in the production of topographical features, and in most of the region the hills, and even slight elevations, will be found to be capped with a sheet of ferruginous sandstone formed in this way, and giving rise to the elevation by protecting the strata from washing away. Wherever the red-colored sands and beds of pebbles rest upon a sheet of impervious clay the conditions for the formation of these rocks exist.

AGRICULTURAL FEATURES.—The red or yellow loam, above mentioned as overlying the stratified sands and pebbles of the drift, forms all the best upland soils of this region; but in places the underlying sands occupy the surface, forming very light soils, which may produce well for a while, but are soon exhausted. Between these two extremes there are many grades of soils resulting from their intermixtures. The loam, as above stated, with a variable thickness, overlies the stratified drift, and where the thickness is considerable, from 2 or 3 feet upward, the soils have the usual character of those of the brown-loam uplands. When fresh they will yield under good cultivation from 1,000 to 1,200 pounds of seed-cotton to the acre, but soon fall off in productiveness. Between the streams the country has the character of plateau or table-land, and is not much broken or hilly. The following analyses will show the general nature of the uplands and table-lands soils:

No. 6. *Upland sandy loam* (second class table-lands) from 4 miles east of Prattville, Autauga county, collected by Dr. S. P. Smith. The somewhat sandy top soil is underlaid to the depth of 20 feet by red clayey loam, below

which is a coarse yellow sand alternating with clay. Depth, 8 inches; vegetation, short-leaf pine, red and post oaks, hickory, dogwood, black gum, chestnut, persimmon, etc.; color, yellowish-brown on surface, passing into light-red below.

No. 57. *Brown-loam soil* from near Mulberry post-office, Autauga county, collected by T. D. Cory. Depth, 6 inches; vegetation, one-third pine, with white, post, and red oaks, hickory, dogwood, and black gum; color, light brown, changing below 6 inches to dark red. The fresh land will yield from 800 to 1,200 pounds of seed-cotton to the acre, but after several years' cultivation the yield is reduced to 200 or 400 pounds.

No. 60. *Subsoil of No.* 57. Depth, 6 to 12 inches; color, dark red.

Where the table-lands break off in the direction of the water-courses the top stratum of red loam becomes thinner, and in places is entirely removed, leaving the underlying sands at the surface. In the latter case the lands are scarcely worth cultivating, except in the creek bottoms, and even here the thin sandy soils with sandy subsoils are very soon exhausted. About a third of the tillable lands in the pine woods have a subsoil of greater or less thickness of this red loam, and though the soil is thin, it is moderately profitable to cultivate, because of the clay subsoil. The character of this variety of pine lands will be seen from the following analyses:

No. 3. *Upland pine-woods soils* near Prattville, Autauga county. Depth, 8 inches; vegetation, long-leaf pine, hickory, red, post, and black-jack oaks, dogwood, persimmon, etc.; color, ashy-gray at top, changing to yellowish in subsoil. The fresh land will yield 400 pounds of seed-cotton to the acre.

No. 4. *Subsoil of No.* 3, Autauga county. Depth, 12 to 18 inches; color, yellowish. Soil and subsoil collected by Dr. S. P. Smith.

Lands of the gravelly hills, Autauga county.

	SHORT-LEAF PINE LANDS—BROWN LOAM.			LONG-LEAF PINE LANDS—SANDY.	
	Upland sandy loam near Prattville.	Brown sandy loam near Mulberry.		Uplands pine woods.	
	Soil.	Soil.	Subsoil.	Soil.	Subsoil.
	No. 6.	No. 57.	No. 60.	No. 3.	No. 4.
Insoluble matter	89.100 } 91.940	91.510 } 93.470	84.520 } 89.140	94.170 } 95.560	88.860 } 92.240
Soluble silica	2.840 }	1.960 }	4.620 }	1.390 }	3.380 }
Potash	0.073	0.115	0.136	0.040	0.111
Soda	0.018	0.004	0.010	0.006	0.029
Lime	0.060	0.057	0.109	0.069	0.047
Magnesia	0.061	0.140	0.172	0.052	0.139
Brown oxide of manganese	0.122	0.027	0.171	0.117	0.125
Peroxide of iron	1.577	1.527	2.422	0.744	1.572
Alumina	4.350	0.943	6.078	0.603	4.320
Phosphoric acid	0.077	0.042	0.078	0.062	0.077
Sulphuric acid	0.034	0.013	0.074	0.009	0.002
Water and organic matter	2.200	2.888	2.477	2.807	1.660
Total	100.518	99.226	100.867	100.069	100.322
Hygroscopic moisture absorbed at	3.882 16 C.°	2.905 28 C.°	5.39 29 C.°	1.916 24 C.°	6.079 19 C.°

The analyses of brown-loam soils show deficiencies in the principal elements of plant-food, potash and phosphoric acid, and also in lime, showing these to be essentially inferior soils. There is an important difference, however, between the soil and subsoil (Nos. 57 and 60) in their retentiveness of hygroscopic moisture, as shown by the determinations, and the subsoil is also somewhat richer in lime and in plant-food than the top soil. Deep plowing is, therefore, at once suggested as a means of improvement. Manures will be well retained both by subsoil No. 60 and by loam soil No. 6, which is intermediate in composition and physical properties between soil No. 57 and its subsoil. In the pine-woods lands the soil is seen to be lacking in all the elements of fertility, being composed mostly of sand, with very slight retentive power. Stimulant manures will do little good except for a very short time. For permanent improvement nutritive manures are necessary. The subsoil is superior in all respects to the top soil, and deep plowing will be attended with good results. The absorptive power of this subsoil is quite marked for so sandy a material, and this property, probably more than anything else, makes it possible to cultivate such soils with profit.

In some parts of this region there is a kind of pond lands, which, when drained, will produce very well for a year or two, but are then apparently completely exhausted. The accompanying analysis shows its chemical nature:

No. 61. *Pond-land soil* (exhausted) near Mulberry, Autauga county, collected by T. D. Cory. Depth, 12 inches; vegetation, mostly sweet gum; color, a dark gray.

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Pond-land soil (exhausted) near Mulberry, Autauga county.

	No. 61.
Insoluble matter	78.630 } 84.675
Soluble silica	6.045 }
Potash	0.193
Soda	0.094
Lime	0.019
Magnesia	0.106
Brown oxide of manganese	0.079
Peroxide of iron	0.810
Alumina	7.951
Phosphoric acid	0.076
Sulphuric acid	0.152
Water and organic matter	6.101
Total	100.328
Hygroscopic moisture	7.697
absorbed at	27.8 C.°

In this soil it would appear that a deficiency in the lime is the chief cause of its rapid exhaustion, and liming is the first improvement indicated. It is lacking also in potash and phosphoric acid.

The bottom soils of this region vary with the surrounding uplands, and are, as a rule, easily cultivated and quite fertile, as they contain the best portions of the soils of the uplands. The second bottom or hummock soils are, in great measure, similar to the upland soils, but are usually somewhat stronger. The best farming lands in the region are to be found in the river hummocks or second terraces, and the general character of both will be seen from the following analyses:

No. 9. *Alabama river first-bottom soil*, 4 miles west of Montgomery, in Autauga county, collected by Dr. S. P. Smith. Depth, 8 inches; vegetation, red and white oaks, poplar, beech, hickory, sweet gum, elm, slippery elm, walnut, wild cherry, ash, sourwood, dogwood, grapes, and muscadines; color, light-brown top soil, with yellowish subsoil.

No. 20. *Warrior river hummock soil* (virgin), plantation of James R. Maxwell, near Tuscaloosa, collected by James R. Maxwell. Depth, 6 inches; vegetation, originally a dense cane thicket, with some sweet gum and red oak; color of the top soil, a light to dark brown, changing at the depth of 10 inches to a reddish-brown. The fresh land will produce 1,000 pounds of seed-cotton or from 50 to 60 bushels of corn to the acre.

No. 66. *Warrior river hummock soil* from the same locality as the preceding, but taken to the depth of 14 inches.

No. 21. *Warrior river hummock soil* (cultivated twenty years) from the same locality. Depth, 14 inches; vegetation, same as No. 20.

No. 22. *Warrior river hummock subsoil*, subsoil of Nos. 20, 21, and 66. Depth, 14 to 24 inches; color, reddish-brown.

Nos. 20, 66, 21, and 22 were collected by James R. Maxwell.

	AUTAUGA COUNTY.	TUSCALOOSA COUNTY.			
	Bottom lands, Alabama river.	Hummock lands, Warrior river.			
	First-bottom soil.	Virgin soil to depth of 6 inches.	Virgin soil to depth of 14 inches.	Soil after 20 years' cultivation to depth of 14 inches.	Subsoil of the three preceding; depth, 14 to 24 inches.
	No. 9.	No. 20.	No. 66.	No. 21.	No. 22.
Insoluble matter	77.080 } 83.117	73.095 } 80.513	69.900 } 80.887	73.339 } 82.116	71.227 } 81.892
Soluble silica	6.037 }	6.518 }	10.987 }	8.777 }	10.665 }
Potash	0.335	0.252	0.448	0.383	0.504
Soda	0.189	0.052	0.033	0.052	0.106
Lime	0.136	0.468	0.343	0.314	0.241
Magnesia	0.303	0.429	0.547	0.502	0.516
Brown oxide of manganese	0.384	0.006	0.190	0.041	0.081
Peroxide of iron	5.357	4.395	5.303	4.590	10.254
Alumina	4.841	5.182	6.004	5.288	2.105
Phosphoric acid	0.137	0.274	0.325	0.214	0.284
Sulphuric acid	0.040	0.071	0.072	0.072	0.034
Water and organic matter	5.230	8.893	6.311	6.617	4.490
Total	100.069	100.535	100.463	100.189	100.597
Humus	1.047	2.310	.....	.....	.....
Available inorganic	0.862	1.255	.....	.....	.....
Available phosphoric acid	0.058	0.112	.....	.....	.....
Hygroscopic moisture	8.193	18.611	8.707	15.836	14.016
absorbed at	17.2 C.°	17 C.°	29 C.°	20 C.°	17 C.°

By its composition the bottom soil is seen to be an excellent soil, and the large crops, especially of corn, which it produces are what might be expected from an inspection of the analysis. It is liable to overflow in many parts, and is therefore less planted in cotton than in grain.

The hummocks are also good soils, having, above the average content of phosphoric acid, a good supply of potash, and a sufficient quantity of lime to make these ingredients available. In comparing the analyses we find that the percentage of phosphoric acid and potash increases with the depth, while the lime decreases in quantity, it being greatest at the surface. They are all sufficiently retentive of moisture, and will hold manures well. The cultivated soil, No. 21, is very little inferior to the virgin soil in the elements of fertility, and the observed difference in the productiveness of the two is doubtless due to the circumstance that the fresh soil contains plant-food in a more easily available form.

It is a matter of experience that when the top soil has been washed off, as, for instance, on the low knolls, the reddish-brown subsoil appears to be, for a time at least, almost barren. This, as we see from the analysis, cannot be due to any deficiency in the elements of plant-food, and must, therefore, be owing to the physical and chemical conditions of the material, to its compactness, want of vegetable matter, and perhaps also of lime, to render available the plant-food which it actually contains. Thorough breaking up, plowing in of green crops, and applications of lime would undoubtedly in a very short time make this subsoil quite as productive as the soil.

The humus determination of the virgin soil, No. 20, shows 0.112 per cent. of available phosphoric acid, a very large proportion of the total amount present.

OAK AND HICKORY UPLANDS, WITH LONG-LEAF PINE.

The belt of country lying between the central prairie region on the north and that of the long-leaf pine region on the south is characterized by the almost universal presence of the long-leaf pine among the timber trees, but with it, in the upper part of the belt, are associated the upland oaks and hickories in perhaps equal proportions, but diminishing in frequency southward, and thus forming a transition into the long-leaf pine region proper. Under this head are embraced parts of the following counties: Sumter, Choctaw, Clarke, Marengo, Wilcox, Monroe, Conecuh, Butler, Crenshaw, Covington, Coffee, Pike, Montgomery, Bullock, Barbour, Dale, and Henry, and the area included is about 8,095 square miles.

While the upper and lower parts of this division in their extreme characters differ widely, they nevertheless shade off imperceptibly into each other, and it is not possible, except in a general way, to draw the line between them. In the upper half the prevailing soils are brown sandy loams, with a growth of upland oaks and hickories and some short-leaf and long-leaf pines; in the lower half the soils are more sandy, and the timber consists largely of long-leaf pine, along with black-jack oak and others which usually affect sandy soils. It will be most convenient to speak of this region under the two heads of brown-loam uplands and pine uplands, bearing constantly in mind the fact that these names merely serve to call to mind the predominant characters of the two sections, and that in each there are tracts of greater or less extent which have all the distinctive marks of the other.

1. BROWN-LOAM UPLANDS.—This section forms the upper or northern half of the region which we are describing, and embraces parts of the counties of Sumter, Choctaw, Clarke, Marengo, Wilcox, Monroe, Butler, Crenshaw, Montgomery, Pike, Bullock, Barbour, and Henry, with an area which is approximately 4,105 square miles.

In the lower part of Sumter and Marengo and the upper part of Choctaw, Clarke, and Wilcox counties the lignitic or Lower Tertiary strata, which underlie this division, consist of laminated clays and sands, to which are subordinated beds of lignite and of shell marls, often very rich in greensand or *glauconite*. Eastward, however, the lignitic character of the deposits to a certain extent disappears, the beds becoming more exclusively marine, and consisting of sandy materials, often highly fossiliferous.

In Barbour, Bullock, and Pike counties the northern limits of these uplands adjoin the blue marls and other beds of the Upper Cretaceous formation, from which they are separated west of Lowndes county by a belt of flatwoods. The underlying beds, however, both east and west, are in most cases at sufficient depths below the surface to exercise comparatively little influence upon either soils or topography.

Exceptions to this are seen in Wilcox, Marengo, and Choctaw counties, where the beds of greensand marl above mentioned are brought to the surface by denudation and give rise to lime-hills, which, in the character both of their soils and their rugged topography, resemble the lime-hills of the Jackson group farther south. A well characterized belt of such lime-hills may be traced from Lower Peach Tree, in Wilcox county, westward through northern Clarke and Choctaw to the Mississippi line. This belt runs parallel with, and a short distance north of, the rocky hills formed by the sandstones and other strata of the Buhr-stone group.

A soil of this lime-hills region was collected about 10 miles west of Lower Peach Tree, in Wilcox county, of which the analysis is given on page 42.

No. 140. *Lime-hills soil*, 10 miles west of Lower Peach Tree, Wilcox county. Depth 8 inches; color, yellowish-gray, with a slightly greenish tinge; vegetation, chiefly beech, but mixed with hickory, white oak, sweet gum, a few short-leaf pines and *Pinus glabra*, ash, some Spanish oak, poplar, pig-nut, sourwood, cucumber trees, holly, and sour gum.

Lime-hills soil, Wilcox county.

	No. 140.
Insoluble matter	75.550
Soluble silica	1.134 } 76.684
Potash	0.174
Lime	0.184
Magnesia	0.014
Brown oxide of manganese	0.082
Peroxide of iron	5.545
Alumina	7.772
Phosphoric acid	0.229
Sulphuric acid	0.060
Water and organic matter	8.922
Total	99.616
Hygroscopic moisture	17.067
absorbed at	10.5 C.°

In this soil the percentage of phosphoric acid, as also the hygroscopic moisture, is high; the lime and potash sufficient.

Another belt, characterized by the occasional appearance of calcareous soils, runs parallel to and some 15 or 20 miles north of the one just described, and is well displayed, for instance, near Luther's store, in Marengo county. Similarly in eastern Alabama the prevailing loam soils are, in places, greatly improved by admixture with the greensand marls occurring there. Otherwise, the superficial beds of loam, sand, and pebbles determine almost exclusively the agricultural and other characters of the region.

On account of the almost universal presence of a bed of red or yellowish-red loam overlying the sandier materials of the drift the topography of this region is quite varied because of the unequal degrees of resistance thus offered to denudation. The water-sheds are usually of the nature of table-lands, which break off toward the streams in somewhat rugged hills. The loam rests upon beds of sand and pebbles, as above stated, and hence an abundance of good freestone water in every part of this region, even in the driest seasons.

The agricultural characters of the upland region are determined almost exclusively by the nature of these superficial beds, and the distribution of the soil-varieties will be understood from the following considerations: The rocks of the country were covered with beds of sand, and in some places with beds of pebbles, which in turn were overlaid with a red or brownish-yellow loam of 20 or 30 feet thickness. The latter forms, in most cases, the soils and subsoils of this region, with the exceptions to be noted hereafter. Wherever the thickness of the loam is considerable, say 5 feet and upward, the water-sheds and territory generally formed by it are mostly of the nature of nearly level table-lands, whose general elevation above the main water-courses is 350 or 400 feet. On these table-lands the soil is usually a brown sandy loam, increasing in stiffness with the depth from the surface, and resting upon a subsoil of clay loam of a red or reddish color. The natural growth consists of numerous species of upland oaks, conspicuous among which are the Spanish, post, red, black, and black-jack, and hickories and short- and long-leaf pines.

Upon the table-lands there are varieties of soil depending upon the degree of sandiness, and the deterioration in quality is generally marked by the accession of the pines to the oak growth—short-leaf pine first, then the long-leaf pine. Below a certain depth, or within a certain distance of the top of the underlying drift-sands, the loam becomes more and more sandy, making a very gradual transition to the underlying beds. Along the edges of the table-lands, therefore, and in corresponding positions where the greater part of the loam has been removed, its sandy lower portions, and the sands of the drift itself, form the soils, which are then of inferior quality, as is shown by the growth, which consists of long-leaf pine and black-jack, or of the former alone. Of this character are the sandy pine ridges which are interspersed with the better table-lands. They have a poor sandy soil, which often produces pretty well for a short while, but is soon exhausted. Between the two extremes thus accounted for are numerous gradations resulting from their intermixtures.

It should not be inferred from what has been said that everywhere at elevations 20 or 30 feet below the general level of the table-lands the sands of the drift would be denuded of the loam and alone form the soils, for both the drift and the overlying loam seem to conform more or less to the more prominent topographical features of the country, as if they had been deposited over a surface which had already been eroded in conformity with present systems of drainage. It is otherwise difficult to account for the fact that we constantly find, sometimes 75 or 100 feet below the level of the table-lands, terraces of greater or lesser width having a capping of considerable thickness of the same red loam, underlaid by sand and pebbles, just as is the case on the table-lands themselves; and, even more, the second bottoms of the larger streams often present the same condition of things. At elevations intermediate between these successive plains are the pine ridges. It may be that a part of this is due to the subsequent degradation of the loam and its re-deposition along the slopes and over the lowlands; but this explanation

will not apply to all cases, for we should then always find the greatest thickness of loam at the lowest levels, and often find the relative positions of the loam and the sands and pebbles reversed, which is not the case.

The heaviest or stiffest loams are not, as a rule, found on the highest and broadest of the table-lands, but rather along their borders, where exposed to partial denudation, whence it would seem that upon the level table-lands, where the waters flow off slowly, there is a constant tendency toward increasing sandiness in the top soil, caused by the carrying down from the surface by percolating water of the finer clayey particles. Along slopes, however, the more rapidly flowing waters remove both the finer clay and coarser sand, and the proportion of these two ingredients originally existing in the loam is preserved.

It often happens that the freshly-exposed loam appears to be rather sterile, but this is due to the physical condition, and not to the inferior chemical composition, as may be seen from analyses made of soils from Tuscaloosa county, given under "the gravelly pine hills" division. As illustrating the composition of the sandy varieties of these upland loam soils, the following analyses are presented:

No. 94. *Sandy upland loam soil* from near Clayton, Barbour county, collected by Judge H. D. Clayton. Depth, 12 inches; vegetation, Spanish and other oaks and hickory; color, light yellowish-gray, with a subsoil a shade more yellow. This soil is extensively cultivated and much prized, but it almost invariably rusts cotton.

No. 84. *Upland loam soil* from near Lawrenceville, Henry county. Depth, 10 inches; vegetation, Spanish and post oaks, with a few black-jacks, hickory, chestnut, sour gum, short-leaf pine, and a few long-leaf pines; long moss on some of the trees; color, light yellowish-gray top soil, deeper yellow below, all resting upon a red clay loam at 2 to 3 feet depth.

The composition of the better class of brown-loam soils is illustrated by the following analyses:

No. 18. *Upland brown-loam soil* from 5 miles southeast of Troy, Pike county. Depth, 8 inches; vegetation, red oaks and a few short-leaf pines; color, dark-brown.

No. 19. Subsoil of No. 18. Color, reddish-brown.

Upland brown-loam soils (oak and hickory uplands, with long-leaf pine).

	SANDY LOAM.		BROWN LOAM.	
	Barbour county.	Henry county.	Pike county.	
	Soil.	Soil.	Soil.	Subsoil.*
	No. 94.	No. 84.	No. 18.	No. 19.
Insoluble matter	95.091 } 97.004	95.115 } 96.270	91.965 } 93.880	90.960 } 93.385
Soluble silica	1.913 }	1.155 }	1.915 }	2.425 }
Potash	(*	0.212	0.077	0.150
Soda	0.007	0.096	0.013	0.056
Lime	0.010	0.058	0.112	0.048
Magnesia	0.056	0.039	0.094	0.080
Brown oxide of manganese	0.131	0.128	0.044	0.092
Peroxide of iron	0.603	0.803	1.431	1.574
Alumina	1.386	0.703	1.841	3.197
Phosphoric acid	0.025	0.100	0.109	0.072
Sulphuric acid	0.001	0.016	0.015	0.072
Water and organic matter	0.443	2.009	2.137	1.532
Total	99.666	100.434	99.763	100.258
Hygroscopic moisture absorbed at	0.878 5.6 C.°	1.225 23.3 C.°	2.590 19.4 C.°	2.826 18.3 C.°

* Undetermined.

The analyses given on page 49 of upland sandy-loam soil and subsoil from 2½ miles south of Union Springs, Bullock county, may also be consulted, since they are of essentially the same character, being derived from the loam, but which, on account of their relation to the Chunnenugga ridge, have been presented in connection with it.

A comparison of the four analyses above given with those of the gravelly pine hills north of the prairie region will show that they are essentially similar soils, as was to have been inferred from the identity of the material from which both classes have been derived. They are all below the average quality, and are more or less deficient in potash, phosphoric acid, and lime. Enough plant-food in them appears, however, to be in an available form to render them all quite productive for a time. No. 18 is remarkably deficient in potash and No. 94 in lime. No. 94 is also greatly deficient in organic matter and in retentiveness for moisture, but the latter defect is partly remedied by the subsoil, which is a rather stiff loam.

Passing mention has been made of the modifications brought about by the greensand and other marls which form a part of the underlying strata of this division. The more important soil-varieties thus produced are described

hereafter. The reaction of the greensand deposit upon the loam often produces a soil remarkable for its deep-red color and for its fertility. These soils occur in detached bodies in the brown-loam uplands, and have been observed more frequently in the eastern part of the region, though occurring probably in all parts of it. Near Clayton, in Barbour county, and Greenville, in Butler, are characteristic occurrences. The top soil is usually reddish-brown, and the deep-red color is better seen in the subsoil. The vegetation consists of Spanish, white, red, black, and post oaks, hickory, short-leaf pine, sweet gum, sour gum, dogwood, persimmon, chestnut, and chincapin. When fresh, such soils will produce 1,000 pounds of seed-cotton or 20 bushels of corn to the acre. A partial analysis of a red soil from near Greenville shows some 97 per cent. of insoluble matter in the top soil, which is quite high for so good a soil, but the loamy character of the subsoil remedies this defect.

In the western counties of this region the lignitic clays and sands are interstratified with several beds of greensand marl, and where these come to the surface prairie spots and a kind of lime-hills are produced, which are perhaps best seen in Wilcox, Marengo, northern Clarke, and Choctaw counties. One of these marl-beds exposed in the river bank at Nanafalia landing is composed chiefly of the shells of a small species of Gryphea (*G. Thirsæ*). This bed comes to the surface in many places near Luther's store, in Marengo county, and probably also in parts of Choctaw county, producing very characteristic prairie spots.

Another marl-bed which is seen on the Tombigbee river at Wood's bluff and on the Alabama river above Lower Peach Tree gives rise to a belt of lime-hills extending from the Alabama river, through Wilcox, Clarke, and Choctaw counties, to the Mississippi. The best display of these hills is probably seen between Choctaw Corner and Lower Peach Tree. The marl-bed containing greensand is there at least 100 feet above the general drainage, and has, both above and below it, laminated gray clays, in the lower part of which occur one or two thin seams of lignite. The country is very much broken, and in this respect bears a striking resemblance to the lime-hills region of southern Clarke, etc.

The drift-beds have been generally removed, and the soils mostly come directly from the disintegrated clays and the associated marls. The most characteristic soil is a heavy clayey loam of a yellowish-gray color with a slightly greenish tinge. Where the drift loam is present the color is more decidedly red and the soil more sandy; and where this loam is absent, and the marl is least felt, the crumbling clays yield a heavy, dark-colored argillaceous soil. The vegetation is chiefly beech, which grows both on hills and in the bottoms. With it are associated hickory, pig-nut, white and Spanish oaks, sweet gum, ash, poplar, sourwood, holly, sour gum, cucumber trees, numerous spruce or swamp pines (*P. glabra*), and a few short-leaf pines. These hills are very generally cleared and in cultivation, which is proof of their fertility. Their usually steep slopes are, however, soon denuded of soil, and where turned out they are rapidly cut up by deep and unsightly washes.

Westward from Wilcox county, so far as my observation goes, these lime-hill areas are more sparingly interspersed among the other classes of soils which are derived from the drift. The lime-hills of northern Monroe are no doubt also partly of this character. No analyses have yet been made of the calcareous soils of this particular section.

The second bottoms of this section, especially those of the larger streams, are among the best farming lands of the state. The analyses of the second-bottom soils from Autauga and Tuscaloosa counties are illustrations in point, although they have been presented under the division of the gravelly pine hills. The following analysis of a hummock soil from the Alabama river is presented as an additional illustration of the character of the second-bottom soils of the brown-loam region:

No. 92. *Second-bottom soil* of the Alabama river, in Black's bend, 5 miles east of Lower Peach Tree, Wilcox county. Depth, 9 inches; vegetation, sweet gum, short-leaf pine, Spanish, red, and white oaks, poplar, haw, and hackberry; color, brown, speckled with red.

Second-bottom soil of Alabama river, Wilcox county.

	No. 92.	
Insoluble matter	86.510	89.779
Soluble silica	3.269	
Potash		0.168
Soda		0.074
Lime		0.221
Magnesia		0.055
Brown oxide of manganese		0.184
Peroxide of iron		1.783
Alumina		2.290
Phosphoric acid		0.200
Sulphuric acid		0.073
Water and organic matter		4.510
Total		99.337
Hygroscopic moisture absorbed at 22.2 C.°		5.916

A comparison of this analysis with those of the second-bottom soils of the Alabama and Warrior rivers, previously alluded to, will show that this, while somewhat more sandy, is still a good soil. The proportion of phosphoric acid is large; that of potash adequate; and the large percentage of lime renders the soil thrifty by putting in an available form all the nutritive ingredients.

2. PINE UPLANDS.—We have seen that the lower or southern half of the oak and long-leaf pine uplands is characterized by the predominance of the long-leaf pine among its timber and by the usually broken and hilly nature of its surface. This section embraces parts of Choctaw, Washington, Clarke, Monroe, Conecuh, Butler, Covington, Crenshaw, Pike, Coffee, Barbour, Dale, and Henry counties, and has an area of about 3,990 square miles.

The surface characters of the eastern and western parts of this section are quite different. In the counties of Choctaw, Clarke, Monroe, northern Conecuh, and southern Butler the siliceous rocks of the Lower Tertiary or Buhr-stone formation lie near the surface and give rise to high and rugged rocky hills. In the other counties above named these rocks are more or less deeply covered with the more recent beds of sand and pebbles, and the surface is correspondingly much less broken. In this part of the section the surface is generally undulating, but sometimes it is hilly, particularly in the vicinity of the water-courses. In such positions, and sometimes along the ridges, the siliceous rocks above spoken of appear at the surface, but they fail generally to have much influence upon the topography.

The drainage area of the Chattahoochee river in Alabama seems to be characterized by a prevalence of sand among the surface materials, and quite extensive areas covered with deep sand-beds are not uncommon, as, for instance, in Dale county, around Ozark, and between that town and Newton. Throughout the entire pine-uplands section, within 25 or 30 miles of the principal streams, pebbles commonly underlie the surface loams, and the size of the pebbles and the thickness of the beds seem to increase with the approach to the stream. Along some of the rivers, as the Chattahoochee, the pebble beds may be followed nearly to the Gulf.

As the name indicates, the long-leaf pine is the prevailing tree over this whole section. Upon some of the poorer ridges this forms almost the only timber, but with it are usually associated black-jacks and high-ground willow oaks, the latter especially where the soil is most sandy. From this, the prevailing timber growth, it may be inferred that the soil is generally a rather poor sandy loam, with subsoil of a similar nature.

Along the northern edge of this belt many of the dividing ridges are of the nature of table-lands, supporting a mixed growth of the long-leaf pine, with post, red, black, and Spanish oaks, in addition to the black-jack. The same mixed growth is frequently seen also where the divides break off toward the water-courses, and in both cases the sandy soil is underlaid at moderate depths by a red clayey loam. Thus the line between the oak uplands and the pine hills is a shadowy one, and each of these divisions sends into the territory of the other spurs often of considerable length. Along the southern edge there is a similar blending of the characters of the pine hills with those of the lime-hills and the undulating pine lands.

Between these two divisions of the pine lands there is much less difference in the soils and natural productions than in the surface topography. The typical sandy loam, both of this and the undulating pine lands, is shown in the analysis of the soil from near Andalusia, in Covington county. On the other hand, the better class of upland soils in this division approach in composition the oak upland soils of the preceding division, and are sufficiently well represented in the analysis of the soil from near Lawrenceville, in Henry county (brown-loam uplands).

In the division of the lime-hills there are tracts which have all the characters of the pine hills, lying usually upon the higher ridges, as has been fully set forth under that head.

North of the prairie belt the gravelly pine hills have great resemblance to this division both in soils and topography, and the composition of the numerous soil-varieties occurring here can be seen by referring to the analyses given under that division. No analyses have as yet been made of any of the soils of this particular division, but the references given will illustrate the composition of all its principal soil-varieties.

The soils of the first and second bottoms are light and sandy, but quite productive, and form the greater part of the cultivated lands in this division, since the uplands are in general too poor for profitable cultivation. Where the red-loam subsoil is near the surface, and the various species of upland oaks are associated with the long-leaf pine, there is, as before stated, a great improvement in the soil, and the land is generally under cultivation; but these areas approach in character the oak uplands, and are, as a body, found in the upper part of this section and on the divides.

UPPER OR CENTRAL PRAIRIE REGION.

This forms a belt running somewhat diagonally across the state, having a width of some thirty miles near the Mississippi line, but narrowing down toward the east, and almost disappearing in Russell county, on the eastern border of the state. The prairie region includes parts of the following counties: Pickens, Sumter, Greene, Hale, Marengo, Perry, Dallas, Autauga, Lowndes, Butler, Montgomery, Crenshaw, Bullock, Macon, Russell, and Barbour, and embraces an area which is approximately 5,915 square miles.

GENERAL DESCRIPTION AND SUBDIVISIONS.—While under this name are included all those parts of central Alabama where the prairies occur, only a part, and not the largest part, of the area is of the genuine prairie character. As here used, the term "prairie" does not always mean a timberless region, but refers rather to the character of the soil, the most important varieties of which are described further on.

The Cretaceous formation upon which this region is based is in Alabama made up of three parts. The Eutaw group consists of clays and sands, which are for the most part so deeply covered with beds of stratified drift as to have little or no influence upon the soils or topography. Overlying this group is a great thickness of an impure argillaceous limestone interstratified with clays, called the rotten limestone. The disintegration of these beds gives rise to the true prairie soils. The uniformity in the composition of the rotten limestone has its influence on the topography of the region, which is a low trough, with gently undulating surface, bounded north and south by hills which rise two or three hundred feet above the general prairie level. The monotony of the plain is relieved by the occurrence, here and there, of ridges and conical hills capped with the pebbles and sand-beds of the drift, which at one time overspread the entire region. The irregularities of surface produced by the wearing away of the rotten limestone itself are comparatively insignificant. In much of this region the rocks lie very near the surface, and large trees are wanting entirely; but, on the other hand, there are many fine groves of oaks, walnut, poplar, etc.

In all the prairie country the surface water is strongly impregnated with lime, and is often insufficient in quantity. For a supply of this necessity recourse is usually had to artesian wells and cisterns, and, for farm purposes, to shallow ponds. Cisterns are dug into the limestone rock, and usually no brick-work is necessary. Wherever the drift and loam overlie the rotten limestone upon the ridges an adequate supply of pure freestone water is always to be had, and these sandy ridges are usually chosen as the sites for dwelling-houses, and often for towns and villages. From the uniformity of level the waters falling upon this region are very slowly drained away, and much of it soaks into the ground, converting it into a mud, which, when worked up by vehicles, soon renders the roads nearly impassable.

Next above the rotten limestone lie the beds of the Ripley group, consisting of hard, sandy limestone, sometimes crystalline, underlaid by strata of bluish micaceous marls. In contrast to the preceding division, the topography of the Ripley group is varied, the surface being more or less hilly, and while the beds of the stratified drift nearly always overlie the strata of this group, the country rocks come to the surface in many localities, giving rise to very marked agricultural features. The depressions are mostly filled with the materials of the drift, mingled more or less with the calcareous matter of the formation, but the limestone makes its appearance at the surface in numerous bald prairie spots, which are usually upon the tops or sides of the hills. The alternations of hard and softer strata make the hills usually rough and precipitous, and in some localities, as in Little Texas, in Lowndes county, the broken character of the country is extreme.

A belt of this hill prairie country usually borders the black prairie region on the south for most of the way across the state, at least from Marengo county eastward. In some places the bald prairie hill-tops are a conspicuous feature, as in Lowndes and Montgomery counties, but more commonly the limestone upon the ridges is covered with the drift, and then the country has the usual characters of the oak and pine uplands. Of such nature is the Chunnenugga ridge, which has its counterpart in the Pontotoc ridge of northeastern Mississippi. These occurrences will be more particularly described under the several counties.

In the eastern part of the state the bluish micaceous marls are exposed (by removal of the superficial drift) along the drainage slopes of certain streams which flow into the Chattahoochee river, and there is then produced a third class of lands, which characterize the low grounds of the Cowikee and Bear creeks, in Barbour and Russell counties. In this section of the state these blue-marl lands become as characteristic as the black prairie lands of the west, as was long since remarked by Professor Tuomey. In topography, the blue-marl lands are much like the oak and pine uplands, and the surface soil also is in a great degree composed of the same materials. To bring into prominence these three well-marked agricultural regions I have proposed the following division of the central prairie region:

The black prairie or canebrake region.
The hill prairies (Chunnenugga ridge, etc.).
The blue-marl lands.
The special agricultural characters of each of these divisions will be given under their several heads.

THE BLACK BELT OR CANEBRAKE REGION.

This division of the prairie region is underlaid by the rotten limestone before described, and in its topography and soils shows considerable uniformity. From the great thickness of the rotten limestone this division is much more widely spread than either of the others, occupying about 4,365 square miles. It is found in all the counties above included in the prairie region, except those on the extreme eastern border of the state—Barbour and Russell—where it is replaced by the blue-marl lands. The general character of the topography has already been given.

Throughout the canebrake or black belt the coating of drift which so generally overlies all the country rocks of the southern division has been more or less completely removed by denudation, but patches of it are left in places, chiefly upon the ridges and along the slopes, and these play an important part in the production of soil varieties.

(1.) Where the rotten limestone lies at the surface unmixed with the drift, it yields, on disintegration, a gray or greenish-gray clayey, calcareous soil, which becomes black or very dark-colored when mixed with vegetable

matter. The subsoil of the cultivated lands is usually of a lighter color than the top soil, and passes gradually into the lime rock at varying depths. A distinction is often made between the uppermost parts of this rock where it has been exposed to weathering, as it then resembles a whitish or chalky clay, quite different from the unchanged rock, which is frequently spoken of as the blue-marl rock. Where the depth of soil is sufficiently great it supports a varied growth of trees, among which the several species of oaks, ash, gums, walnut, and poplar are prominent.

From the slight elevations the soil has sometimes been washed away, and bald spots are left, where the bare rock often partly forms the surface (bald prairies). Such places are not suitable for cotton, but produce corn and oats very well. The yield of seed-cotton of the fresh black land is variously estimated between 800 and 1,800 pounds, the average of the estimates being about 1,200 pounds. Perhaps not more than one-fourth of the cultivated lands of this particular division have this kind of soil, which has, however, on account of its great and lasting fertility, given character to the entire region. The following analyses of black prairie soils, selected from the different parts of the state, will best show their character:

No. 30. *Black prairie soil* from 8 miles northeast of Livingston, Sumter county (on Jones' Bluff road), collected by Dr. R. D. Webb. Depth, 10 inches; vegetation, a few post, red and black-jack oaks, cedar and prairie white oaks; color, black or very dark gray.

No. 32. *Black prairie soil* from the edge of an open prairie 2 miles north of Livingston, Sumter county, collected by Dr. R. D. Webb. Depth, 10 inches; vegetation, post, red, black-jack, and prairie white oaks, cedar, walnut, and cane; color, black.

No. 16. *Black prairie soil* from W. M. Stakeley's, 4 miles east of Union Springs, Bullock county. Depth, 12 inches; vegetation, post and red oaks and short-leaf pine, haw, and crab-apple; color, black, with yellowish stiff clay subsoil resting on the rotten limestone; color of subsoil, black, passing below 6 inches into yellowish, waxy clay. In the sloughs and drains of the prairies the cream of the soil collects from time to time, and there is formed a soil of great thickness and strength. The subjoined analysis will show the character of such deposits.

No. 77. *Black prairie slough soil*, 8 miles south of Montgomery, Montgomery county. Depth, 8 inches; vegetation, chiefly white oak and hickory; color, black.

Black prairie soils.

	SUMTER COUNTY.		BULLOCK COUNTY.	MONTGOMERY COUNTY.
	8 miles northeast of Livingston.	2 miles north of Livingston.	4 miles east of Union Springs.	Prairie slough.
	Soil.	Soil.	Soil.	Soil.
	No. 30.	No. 32.	No. 16.	No. 77.
Insoluble matter	46.990	81.745	57.831	25.188
Soluble silica	17.920 } 64.910	2.346 } 84.091	10.431 } 68.262	23.792 } 48.980
Potash	0.444	0.205	0.288	0.441
Soda	0.077	0.076	0.027	0.119
Lime	1.961	0.960	0.981	8.678
Magnesia	0.603	0.061	0.802	1.170
Brown oxide of manganese	0.108	0.192	0.452	0.173
Peroxide of iron	6.944	3.843	7.855	7.074
Alumina	12.418	6.168	11.488	15.565
Phosphoric acid	0.102	0.318	0.507	0.201
Sulphuric acid	0.072	0.152	0.030	0.125
Carbonic acid	.....	.....	.....	5.728
Water and organic matter	11.720	4.075	8.036	11.589
Total	99.359	100.141	98.728	99.843
Humus	2.830	2.000	.....	2.460
Available inorganic	0.740	1.430	.....	1.874
Available phosphoric acid	0.060	0.108	.....	0.637
Hygroscopic moisture	1.283	6.042	14.489	19.992
absorbed at	23.3 C.°	27 C.°	17 C.°	7 C.°

All the above are good soils in every particular. The potash and phosphoric acid is adequate in all, and very high in Nos. 16 and 32, as is also the lime. No. 32 is deficient in organic matter, being taken from the edge of an open prairie, and it has also less capacity for moisture.

(2.) While the drift and loam have, as a rule, been removed from the rotten limestone, there are many places where they still remain, and where they have protected the underlying rocks from degradation, thus producing the sandy ridges and brown loam table-lands which often so agreeably relieve the monotony of the prairie region. These superficial beds give rise to a variety of soils, which upon many of the ridges do not differ from the loam soils of other localities, since they are formed of the same materials.

Where the loam is mingled with the prairie soils, as is the case along the slopes of the sandy ridges before mentioned, and where they occupy the slight depressions in the limestone, yellow or mulatto soils are formed, upon which the post oak is the most characteristic tree, for which reason they are often called post-oak prairies. With this tree are also associated the short-leaf pine and some black-jack and other oaks and hickories. All these trees are usually draped with long moss.

The post-oak prairie soils are mostly rather stiff calcareous loams of yellowish to reddish colors, having a subsoil of red or yellow-clay loam, which sometimes becomes more sandy with increasing depth, but which often retains much the same character down to the unchanged limestone rock (10 to 20 feet). On account of their position these lands are usually well-drained, and with good seasons are of easy tillage. As cotton lands they are perhaps quite as desirable as the black lands above described. The subjoined analysis will show the composition of an average soil of this kind.

No. 17. *Post-oak prairie soil* from Major Wright's, 3 miles from Union Springs, Bullock county. Depth, 12 inches; vegetation, post oak, draped with long moss, short-leaf pine, hickory, black-jack and some red oaks; color, 4 to 5 inches dark gray, then a sticky red clay, and below that a yellowish clay with "lime balls".

Post-oak prairie soil, Bullock county.

	No. 17.	
Insoluble matter	71.366	83.347
Soluble silica	11.981	
Potash		0.209
Soda		0.016
Lime		0.371
Magnesia		0.290
Brown oxide of manganese		0.055
Peroxide of iron		6.988
Alumina		6.022
Phosphoric acid		0.251
Sulphuric acid		0.073
Water and organic matter		2.888
Total		100.505
Humus		0.718
Available inorganic		2.426
Available phosphoric acid		0.015
Hygroscopic moisture		8.574
absorbed at		16.6 C.°

From what has been said, it may easily be inferred that there are all grades of soils, from the brown loams of the hills to the pure black prairie soils, and that the post-oak soils represent a medium between the two.

A comparison of the post-oak prairie soil with those of the black prairies shows that the former, as a rule, has a larger percentage of siliceous matter and less of lime and magnesia; differences which might have been anticipated in considering the modes of formation of the two classes. The analysis above shows a want of vegetable matter and a lower capacity for moisture as compared with the black soils; in other respects it is a fine soil. No. 32 (page 47), however, approaches in composition the post-oak soil except as regards lime.

(3.) The bottom soils of this region vary between very wide limits from the stiff black prairie slough lands, like No. 77 (page 47), which result from the concentration of the black prairie soil to light and rather sandy loams, and have usually enough lime to make them very strong and lasting.

HILL PRAIRIES AND CHUNNENUGGA RIDGE.

A belt of varying width of lands of this character is usually found bordering the prairie region on the south, and, as the hill prairies grade on the one hand toward the black prairies and on the other into the brown-loam uplands, it is somewhat difficult to estimate their extent, or, indeed, often to decide what shall be included in this division; but, restricting ourselves to the hilly region within which occur lands with very calcareous soils, its area may be given at about 1,000 square miles.

The hard sandy and crystalline limestones to which the hills owe their existence have already been mentioned. These alternate with beds of shaly clays of a yellowish and gray color, and this disposition of the strata gives rise to the characteristic topography of the limy prairie hills. The softer clays are easily washed away, and the limestone breaks off with perpendicular faces. The surface beds on the higher levels are the sands and loam of the drift, and, where the ridges are broad, they exhibit the usual characters of the brown-loam uplands, being timbered with the trees which grow in such localities, such as Spanish, white, post, and red oaks, hickory, short-leaf pine, sweet and sour gums, chestnut, dogwood, persimmon, etc. The broad ridges of this kind are usually water-

sheds or divides for long distances. The creeks flowing northward into the Tallapoosa and Alabama rivers, and southward into the Pea, Conecuh, Patsaliga, and Sepulga, are divided by the Chunnenugga ridge and its prolongation westward to Lowndes and Butler counties. The thickness of the drift and loam stratum varies with the locality, and in many places it is not more than 25 feet. These ridges and plateaus break off toward the black prairies in a series of rugged hills, along the slopes of which the limy clays are encountered soon after the summits are left. These hills are abrupt knolls, with a surface of a yellowish tenacious clay filled with white concretions of lime.

The timber consists of red, post, and Spanish oaks, short-leaf pine, sweet and sour gum, poplar, white oak, hickory, and ash, and all the trees are usually draped with long moss. In many places the hillsides are bare of vegetation and deeply gashed with gullies, and the surface in such bare spots is often strewn with fossil shells. At a certain stage of drying these clays acquire an extraordinary degree of tenacity, and so clog the wheels of vehicles as to render travel almost impossible. Wherever the sands and loams form the surface the roads are usually very good.

The soils of this region, considered from the point of view of their origin, are of three types: 1. Those derived from the surface beds of drift and loam. 2. Those based upon the calcareous rocks of the country. 3. Those resulting from the intermixtures of the two preceding.

The soils of the first kind exhibit the usual variations, depending upon the quality of the beds. The surface is commonly formed of a loam of several feet in thickness, resting upon sandier beds, occasionally mixed with pebbles. The broader parts of the ridges have often considerable tracts of level table-lands with the usual characteristic oak upland growth, and this passes into the other extreme of the pine hills, with long leaf pine and black-jack, with increasing sandiness of the soil. Between these two are many intermediate grades. Taking all things into consideration, the brown and yellowish soils are perhaps the most desirable of this class, and in their chemical composition they do not differ materially from the similar soils of the loam in other localities.

A well-defined ridge, which acts as a divide between waters flowing north and south, may be followed without interruption from Wilcox county along the line between Butler and Lowndes, through northern Crenshaw, southern Montgomery, and northern Pike, into Bullock. This ridge has its northern face overlooking the black prairies, usually rather steep and abrupt, while southward it slopes away very gradually, merging imperceptibly into the long-leaf pine and oak uplands. In Bullock county this is known as the Chunnenugga ridge. Its general surface is quite sandy, and a fair estimate of the sandy varieties of the ridge soils may be obtained from the following analyses:

No. 11. *Chunnenugga ridge soil*, 1 mile south of Union Springs, Bullock county. Depth, 6 inches; vegetation, chestnut, short-leaf pine, red oak, and sour gum; color of the top soil, dark gray, changing at 6 inches to a lighter gray, and at 3 feet to a yellowish color.

No. 12. *Chunnenugga ridge subsoil*, same locality as preceding. Depth, 6 to 26 inches; color, light gray.

No. 13. *Upland sandy-loam soil*, 2½ miles south of Union Springs, Bullock county. Depth, 6 inches; vegetation, Spanish and a few post oaks, short-leaf pine, and huckleberry bushes; color of top soil, gray, with a subsoil of light yellowish-gray color, resting on a reddish-yellow loam.

Sandy soils of Chunnenugga ridge, Bullock county.

	NEAR UNION SPRINGS.		SOUTH OF UNION SPRINGS.
	Soil.	Subsoil.	Soil.
	No. 11.	No. 12.	No. 13.
Insoluble matter	94.770 } 95.256	96.810 } 97.870	93.890 } 95.768
Soluble silica	0.486 }	1.060 }	1.878 }
Potash	0.156	0.165	0.209
Soda	0.069	0.107	0.134
Lime	0.081	0.110	0.076
Magnesia	0.069	0.035	0.021
Brown oxide of manganese	0.156	0.065	0.065
Peroxide of iron	0.706	0.490	0.883
Alumina	0.733	0.867	1.260
Phosphoric acid	0.101	0.113	0.058
Sulphuric acid	0.057	0.035	0.083
Water and organic matter	2.642	0.550	2.062
Total	100.026	100.407	100.619
Hygroscopic moisture	1.943	0.822	1.842
absorbed at	18 C.°	17 C.°	19 C.°

From the preceding analyses it will be seen that soil No. 11 does not change very materially from the surface to a depth of 26 inches. For so large a proportion of siliceous and insoluble matter they all show a fair percentage of potash and phosphates, and of lime also, especially the subsoil No. 12. In vegetable matter and capacity for moisture the two soils stand very well. A comparison of these with some sandy upland soils of a preceding region will show great similarity, as might have been inferred from the identity in their origin. All these soils give probably fair returns for a short time, but they cannot hold out well.

Of the second class above mentioned, in which the soils are derived immediately from the country rocks, there are two principal varieties:

(1.) The bald prairie hills, in which the calcareous strata approach very near the surface and the soil proper is of slight depth. This soil resembles the bald prairies of the preceding division to some extent, but the country is more broken, and the hillsides are often badly washed.

(2.) The beeswax hummocks or beeswax flatwoods, the soil of which is a greenish-yellow, clayey material, timbered with black-jack oaks or with pines, forming the post-oak beeswax prairies and the beeswax pine lands of some sections (hog-wallow uplands of Mississippi). The stiff and unmanageable character of this kind of soil stands in the way of its successful cultivation.

The third class of soils, resulting from the intermixtures of the two classes just mentioned, exhibit all the grades between the brown loams of the uplands and the stiff beeswax soils above described. Upon these mixed soils the post oak is a characteristic growth, and the post-oak lands of this division are, in general, like those of the rotten limestone, which are formed in a similar way.

The surface loam is here, as elsewhere, more or less deeply tinged with iron, and in some places the color becomes a dark-red, and both soil and subsoil are filled with concretionary pebbles of brown iron ore. These are known in Alabama as the red gravelly lands, and are similar to the "Buncombes" of Pontotoc ridge, in Mississippi. In both states they are distinctly connected with calcareous strata. While these soils are fertile, they are not so desirable as other varieties, since the pebbles dull the plow and the lands are very liable to injury from washing. As yet no analyses have been made of any of these mixed soils, or of the bald hill-top prairies or beeswax lands, so that we can speak only in generalities concerning them.

BLUE-MARL LANDS.

These lands, which are underlaid by a bluish micaceous marl, are for the most part covered with beds of sand, loam, and pebbles of a later age, and it is only along the drainage slopes of certain streams flowing into the Chattahoochee river that the marls are concerned in the formation of the soils. The area over which their influence is felt in the soil is a limited one, and even within this area there are many varieties. It is thus somewhat difficult to fix upon an estimate of the area here included, but it is put provisionally at 550 square miles.

As already stated, the greater part of the territory of the blue marl is covered with later deposits, and bears, therefore, the characters of the brown-loam uplands and of the pine hills, according to the nature of the surface beds. Along the Cowikee and Bear creeks and their tributaries, however, these surface beds have in great measure been removed, and the blue marl and the stratum of joint clay, with which it is interbedded, are exposed. These materials, mixed with the loam from the higher levels, together form the well-known Cowikee lands. Throughout the region the comparatively level clayey or marly lands alternate with ridges capped with a highly micaceous sandy loam. The ridges, as before stated, are sandy, and are timbered with post and black-jack oaks and long-leaf pine; but where the soil becomes more loamy the pines diminish in numbers, and the other species of oaks replace partly or entirely the black-jack.

On each side of the Cowikee and Bear creeks the lands are stiffer, from an admixture of the clay above mentioned, and more productive, because of the presence of lime. On these creeks there are level or gently undulating tracts with a clayey soil, forming a kind of prairie, in which, strange to see, the long-leaf pine is a prominent tree, associated with hickory, white and Spanish oaks, and, in the lower places, with sweet and sour gums and maple, all covered with long moss. In many places the stiff clay subsoil is filled with white concretions of lime, derived probably from the marl. In some of these localities the short-leaf pine replaces the long-leaf species. It is thought by some that the lands on the north side of the creeks are lighter and less charged with lime than those on the south side, and there is a corresponding difference in the growth of the cotton, which on the north side is smaller and more liable to rust after a few years' cultivation of the soil. In the so-called Cowikee lands of this region there are patches of hog-wallow clay, a stiff intractable substance.

The lowlands in this region are inhabited mostly by the blacks, by whom they are cultivated, since the white people suffer from malarial fevers. One analysis has been made of the soils of this region.

No. 96. *Bottom or low-grounds soil*, Cowikee lands, north of Clayton, Barbour county. Depth, 8 inches; vegetation, red, white, and post oaks, hickory, and short-leaf pine; color, brown, changing into light yellowish-gray subsoil.

Low-grounds soil, Cowikee lands, Barbour county.

	No. 96.	
Insoluble matter	73.303	84.895
Soluble silica	11.592	
Potash		0.245
Soda		0.060
Lime		0.280
Magnesia		0.351
Brown oxide of manganese		0.113
Peroxide of iron		2.666
Alumina		5.489
Phosphoric acid		0.113
Sulphuric acid		0.013
Water and organic matter		4.708
Total		98.933
Hygroscopic moisture		5.544
absorbed at		5.6 C.°

As has been said, the Cowikee lands are considered the best cotton lands in the section in which they occur. The analysis shows a fair proportion of potash and phosphoric acid, with a large percentage of lime, by which these are put in an available condition. From the large amount of siliceous matter this soil is easily tilled. The statistical map shows that about 20 per cent. of the whole area formed by these soils is cultivated in cotton.

POST-OAK FLATWOODS REGION.

This region occupies a narrow belt extending from the Mississippi line through the lower part of Sumter and the middle of Marengo to the Alabama river, in the vicinity of Clifton, in Wilcox county, and embraces an area which is approximately 335 square miles.

The flatwoods or post oaks have an average width of perhaps 3 to 5 miles, and a nearly level or gently undulating surface. They are bordered on the northern edge by the hilly prairie region just described, and on the southern by the hills of brown loam, or oak and pine region. The hills of the latter rise to a height of 200 feet above the general level of the flatwoods. These hills encroach upon the flatwoods in some places and recede from them in others, so that the width of the belt is quite variable. The hills are capped with the sand and other beds of the drift, but the laminated clays, which form the substratum of the flatwoods, are to be seen at the bases of most of them, and for several miles the hills have much the same characters as the flatwoods themselves, and might perhaps with propriety be included in this division.

The formation upon which the flatwoods and the adjoining hills are based is a heavy gray laminated clay belonging to the lower or lignitic division of the Tertiary. The flatwoods soil proper is the result of the disintegration of this clay. When wet by the rains, this clay becomes a tenacious, grayish, sticky mass, specked with red, which is in texture much like some of the clay of the prairie hills, but, unlike that, is rather deficient in lime.

The prevailing tree throughout the flatwoods is the post oak, of long, lank habit, but the short-leaf pine, and in places also the black-jack, are associated with it. The post-oak soils are tolerably well suited to the cotton-plant, which grows upon them to the height of 3 or 4 feet and yields from 600 to 800 pounds of seed-cotton to the acre when the land is fresh. From their texture, these soils are generally difficult to cultivate. There seems to be no subsoil, properly speaking, at least none differing essentially from the soil, which continues, without material change, to a depth of 10 or 15 feet, and passes gradually into the dark-gray laminated clay above spoken of. Two analyses of the flatwoods soils or clays and one of a subsoil have been made.

No. 25. *Post-oak flatwoods soil*, 4 miles west of Livingston, Sumter county, collected by Dr. R. D. Webb. Depth, 10 inches; vegetation, chiefly post oak, with some red oak, hickory, and short-leaf pine; color, gray, flecked with red.

No. 26. Subsoil of the above. Depth, 10 inches to 4 feet; color, also like the preceding.

No. 98. *Post-oak and flatwoods clay*, 6 miles south of Linden, Marengo county. Depth, 10 inches; vegetation, chiefly post oaks; color, reddish-yellow, spotted.

Flatwoods soils and subsoils.

	SUMTER COUNTY.		MARENGO COUNTY.
	Soil.	Subsoil.	Clay.
	No. 25[a]	No. 26.	No. 98.
Insoluble matter	67.020 } 77.070	79.662 } 84.693	72.746 } 81.672
Soluble silica	10.050 }	5.031 }	8.926 }
Potash	0.295	0.223	0.416
Soda	0.125	0.059	0.112
Lime	0.198	0.359	0.080
Magnesia	0.610	0.596	0.691
Brown oxide of manganese	0.115	0.073	0.106
Peroxide of iron	6.543	7.711	12.406
Alumina	10.198	3.308	2.473
Phosphoric acid	0.212	0.072	0.103
Sulphuric acid	0.027	0.026	0.061
Water and organic matter	5.031	2.356	1.906
Total	100.424	99.476	100.026
Hygroscopic moisture absorbed at	13.040 28 C.°	12.341 9 C.°	13.941 8 C.°

Of the three analyses above given, No. 98 is perhaps the most characteristic; the others come from near the vicinity of the prairie region, and hence, especially the subsoil No. 26, have rather larger percentages of lime. The potash and phosphoric acid in the others are sufficient in quantity; lime is inadequate, but the large percentage of magnesia shown by all is noteworthy. The same may be noticed in the Mississippi flatwoods soils, and it seems to be characteristic. They are all deficient in vegetable matter, which appears to be a capital defect in all the flatwoods soils analyzed. The addition of lime and the plowing under of green crops and deep cultivation are at once suggested as a means of improvement of these soils, thorough drainage being first of all necessary.

THE LIME-HILLS OR LOWER PRAIRIE REGION.

This agricultural division embraces portions of Choctaw, Washington, Clarke, Monroe, Conecuh, Covington, Crenshaw, and Geneva counties, and occupies a belt which varies greatly in width, as may be seen by referring to the map. In the first-named four counties these prairie spots are more nearly continuous; in the others they appear only in detached bodies, often far apart. The area is put at 1,250 square miles.

From a geological point of view this subdivision includes that part of the state in which the calcareous portions of the Tertiary formation (especially the upper part of the Claiborne and the whole of the Jackson groups) lie at or near the surface. Over much of this territory the white limestone of the Vicksburg group is a conspicuous rock, but it extends also southward far beyond the limits above given, without producing limy or prairie soils. (*a*) The greater part of this area has the characters of the brown-loam uplands or of the pine hills, and it is only in the first and second bottoms and on the summits of the lower hills that the limy soils are to any extent encountered. The prairie or limy spots are interspersed in such a manner among the brown-loam and sandy pine lands that nothing short of a detailed map could show their actual occurrence. The tint on the map is therefore intended to show only the limits between which this kind of soil occurs at all.

Unlike the prairie region of the Cretaceous, there is in this region comparatively little level land, except upon some of the broader table-lands with brown-loam soils. These table-lands break off toward the water-courses in a series of hills, which are capped with pebbles and sand, and which are clothed with a growth of long-leaf pine and black-jack oak. Upon the table-lands the growth is long- and short-leaf pine and the usual variety of upland oaks.

The lower hills, as before stated, have here and there the peculiar black calcareous soil which gives the name to this region, and this soil extends usually to the bottom lands below, where it is, however, mostly tempered with the sandy washings from the uplands. The black prairie soils are generally quite fertile, and most of the hillsides, usually very steep where it occurs, are cleared and under cultivation. In its general features the country made by these rocks is very similar to the hill-prairie region of the Cretaceous.

In Choctaw and Washington counties, near the line of Mississippi, the lime-hills, or rather the prairie lands, are characteristic and numerous, occupying occasionally moderately level tracts of 100 acres or more. Toward the east, however, they diminish in frequency and continuous extent, and are seen no farther east than the lower part

a In the sequel the term "white limestone" is usually made to include both the white or grayish impure limestone of the Jackson group and the commonly purer orbitoidal limestone of the Vicksburg group. This use of the term is fully justified by the practice of the country where these rocks occur.

of Crenshaw county, except a small tract in the adjoining lower corners of Geneva and Henry; but long before this limit is reached the country bears almost exclusively the characters of the long-leaf pine hills, the limy soils being in small, detached bodies.

Soils.—The rock which gives rise to the peculiar soils of this division is an impure argillaceous limestone or calcareous clay stone, bearing often a considerable resemblance to the rotten limestone of the Cretaceous formation, as may be seen by reference to the subjoined analysis.

No. 137. *Impure argillaceous limestone* (Jackson), overlying the shell stratum at Claiborne, Monroe county.

In disintegrating the rock it yields a waxy, gray calcareous clay soil, which becomes black when mixed with vegetable matter. This soil is stiff and difficult to cultivate, but is very productive, and is quite similar to some of the prairie soils of the upper prairie region.

A second soil variety is of loose texture and black color, often full of small rounded fragments of the limestone, some of which are very soft and crumble easily between the fingers. The solid limestone is usually at a considerable depth from the surface. This soil, which characterizes the shell prairies, is one of the best of this division, and rarely fails to yield excellent crops, either of corn or cotton, and when fresh will produce nearly a bale of the latter to the acre. Occasionally loose shells, set free by the decay of the rock, abound in the soil, and it is not uncommon to find masses of these shells agglomerated into a compact and hard rock.

A specimen of this variety of soil from Mr. Robert A. Long's, Sec. 9, T. 8, R. 3 W., in Washington county, was analyzed with the following result:

No. 139. *Loose black-shell prairie soil*, Washington county. Depth, 8 inches; vegetation, dogwood, white and black oaks, sweet gum, ash, short-leaf pine, yellow wood, and buckeye bushes. The soil is loose, black, and full of soft crumbling fragments of limestone.

Impure argillaceous limestone and loose black soil of the lime-hills.

	MONROE COUNTY.	WASHINGTON COUNTY.
	Impure argillaceous limestone.	Loose black soil.
	No. 137.	No. 139.
Insoluble matter	28.304 } 31.314	21.655 } 23.409
Soluble silica	2.920 }	1.754 }
Potash	0.502	0.553
Soda	0.077	0.192
Lime	34.952	29.195
Magnesia	0.743	0.489
Brown oxide of manganese	0.150	0.113
Peroxide of iron	1.708	5.421
Alumina	1.159	5.155
Phosphoric acid	0.096	0.371
Sulphuric acid	0.200	0.462
Carbonic acid	27.471	22.177
Water and organic matter	2.207	12.845
Total	100.765	100.382
Hygroscopic moisture absorbed at	.....	13.56 20.5 C.°

A comparison of the above with the specimen of limestone will show that this soil is hardly anything more than the disintegrated limestone enriched with vegetable matter. The potash and phosphoric acid are much above the average, and the great fertility of this class of soil is easily understood. The large proportion of sulphuric acid suggests the presence of gypsum, which is not uncommon in very many of the soils and clays of this region.

A third variety of soil common in this region is a mixed one, resulting from the reaction of the limestone upon the red loam, which in places overspreads it. This is a stiff, waxy, reddish or chocolate-colored clayey material, difficult of cultivation, but fertile, and in most respects similar to the post-oak prairie soil of the upper prairie region, which it resembles not only in its mode of formation, but also in its timber, which is mostly post oak, associated with some short-leaf pine, hickory, sweet gum, and dogwood, all draped with long moss. The analyses given (No. 91) will show approximately the composition of the red-mixed soil.

A large proportion of the soils throughout this region, as has already been stated, are derived from the superficial beds of drift origin. The two analyses given on page 54 will show their general character.

No. 90. *Upland brown-loam soil*, 6 miles north of Gosport, Clarke county. Depth, 10 inches; vegetation, post, red, and Spanish oaks, short- and long-leaf pine, and some hickory; color, brown.

No. 91. *Underclay subsoil of No. 90.* Depth, 24 to 36 inches; vegetation, as above; color, yellowish-red.

The washings from the uplands often produce a lastingly productive soil, and this variety is common along the creeks of Conecuh county, especially Murder, Bottle, and the tributaries of the former.

No. 89. *Murder creek second-bottom soil*, 2 miles west of Evergreen, Conecuh county. Depth, 12 inches; vegetation, sweet gum, magnolia, white and water oaks, short-leaf and spruce pines; color, brownish-red.

Brown-loam soils and underclay of lime-hills region.

	CLARKE COUNTY.		CONECUH COUNTY.
	Upland brown-loam soil.	Underclay subsoil.	Murder creek second-bottom soil.
	No. 90.	No. 91.	No. 89.
Insoluble matter	87.753	71.652	89.870
Soluble silica	3.087 } 90.840	5.962 } 77.614	1.592 } 91.462
Potash	0.140	0.350	0.140
Soda	0.010	0.048	0.016
Lime	0.096	0.326	0.094
Magnesia	0.066	0.091	0.018
Brown oxide of manganese	0.050	0.153	0.078
Peroxide of iron	1.999	7.408	2.385
Alumina	3.397	8.606	3.355
Phosphoric acid	0.120	0.295	0.122
Sulphuric acid	0.010	0.080	0.005
Water and organic matter	3.080	5.187	2.480
Total	99.808	100.138	100.155
Hygroscopic moisture absorbed at	2.895 23 C.°	14.380 22 C.°	2.653 24 C.°

Nos. 90 and 89 are light loam soils of very fair quality, quite similar to each other, and are not materially different from the soils of the pine lands and oak and pine uplands, which may be consulted in this connection. No. 91, however, comes from a hillside below the level at which 90 was taken, where the sandy surface loam had been removed by washing rains, and in it we see the material which forms the soil of the lime-hills. Under cultivation this would become a black-prairie soil of great fertility. While it is not strictly a soil (having been taken from a wash several feet below the surface), the analysis gives us a fair idea of the character of the soils which give name to this region and of the material to which the deeper roots of cotton must often penetrate from the sandy surface.

THE LONG-LEAF PINE REGION.

In the region of the oak and pine uplands the sandy ridges are usually timbered with long-leaf pine, while the flat table-lands and some of the slopes and the second bottoms have the characteristic oak and hickory growth, with which some short-leaf pine and occasionally long-leaf pine are associated. As we go southward in this region of mixed growth the long-leaf pine becomes more prevalent, and is found both on the table-lands and in the low grounds, at first associated with the upland oaks, but farther south occupying the ground almost entirely in company with the black-jack, high-ground willow, and turkey oaks, and other trees, which are at home only upon the sandiest soils. At the same time the shrubby undergrowth gradually disappears almost entirely, and we are thus ushered into the open pine woods. Similarly with the topography, the hills of the preceding section gradually diminish in height and abruptness, and the country becomes undulating or rolling rather than hilly, and southward sinks away into the flat lands of the coast. The whole area of the long-leaf pine region, as thus limited, is about 7,790 square miles. The counties included are named below under the three subdivisions, which are in great measure based upon topographical characters. These subdivisions are:

The long-leaf pine hills.
The open, rolling pine woods, with lime-sinks.
The pine flats.

LONG-LEAF PINE HILLS.

In southeastern Mississippi the pine hills, which characterize the lower part of that state, flatten out eastward toward the Alabama line, thus forming a transition into our open, rolling pine woods. That part of Washington county to which the deep-green color of the pine hills has been given on the map does not differ essentially from that part which is designated as open pine woods, except in being more broken, and it is not necessary to give a separate account of its agricultural features, which are the same as those of the next succeeding division. The area of this pine hills or transition region, which is altogether in Washington county, is about 100 square miles.

ROLLING AND OPEN PINE-WOODS AND LIME-SINK REGION.

This region includes parts of the following counties: Washington, Mobile, Baldwin, Clarke, Monroe, Conecuh, Escambia, Covington, Coffee, Geneva, Dale, and Henry, and embraces an area of 6,570 square miles.

The territory here included is underlaid throughout by the white or orbitoides limestone of the Upper Eocene or Vicksburg age. The limestone, however, is in great measure covered with the sands and loams of a later period. Where this rock lies above the drainage level (which is more particularly the case in the southeastern part of the state, where the influence of the elevation of the Florida peninsula is felt) it is pitted with caverns and traversed by underground passages. The falling-in of the roofs of such caverns causes sinks or depressions, which are sometimes filled with water, forming lakes and ponds, and the subterranean waters, flowing through the channels above mentioned, emerge as big springs. In the southwestern part of the state the limestone sinks gradually away below the drainage level, and its influence on the topography is comparatively slight.

The prevailing surface material throughout the whole region, being sandy and more or less loose and porous, quickly absorbs the waters falling upon it, and the formation of deep gullies has thus been prevented, the face of the country being in general slightly rolling, with no great differences in elevation. In some places, especially within the drainage areas of the Chattahoochee and Alabama rivers and in the northern parts of this region, the admixture of red-clay loam with the sands brings about modifications both of the topography and of the soils, because of the varying degrees of resistance to denudation and the varying qualities of the admixtures of the two materials.

Upon the uplands throughout this region the prevailing growth is the long-leaf pine, associated with little or no undergrowth, but with black-jack, turkey, and high-ground willow oaks, and some hickories. Upon the sterile sandy ridges the growth is stunted, and scrubby oaks of several species are associated with the scrubby pines. The headwaters of the streams are found usually in slight depressions and swampy tracts, with a growth of magnolia, bay, gum, juniper, short-leaf pine, water oak, etc. The open swamps in the region have the richest and most varied herbaceous flora, some characteristic species of which have been given on page 57 in the floral list prepared by Dr. Charles Mohr.

The absence of all underbrush in many of the pine forests enables one to see for great distances between the straight trunks of the pines, and over the rolling land thus unobstructed by undergrowth a wagon may be driven in any direction without following any beaten track. The pines shade the ground comparatively little, and a great variety of grasses and leguminous plants flourish and give sustenance to herds of cattle and sheep. This region cannot be called a good farming country, though tolerably fair crops are raised in the more favored localities, such as low grounds. The raising of cattle gives support to many of the inhabitants, and the pines to many more, both in the lumber and the turpentine which they yield.

The prevailing soil of this region, as has already been said, is sandy, and of a gray or ash color. In the better spots the color is a dark gray. This is the soil of the better class of pine lands, and its composition may be seen from the subjoined analysis. With some assistance from fertilizers very fair crops of cotton and corn are produced.

No. 88. *Upland pine-woods soil*, 13 miles east of Andalusia, Covington county. Depth, 10 inches; vegetation, long-leaf pine, post, Spanish, black-jack, and high-ground willow oaks, with occasional small hickories; color, brownish-gray.

Upland pine-woods soil, Covington county.

	No. 88.	
Insoluble matter	90.815	92.390
Soluble silica	1.575	
Potash		0.170
Soda		0.036
Lime		0.085
Magnesia		0.032
Brown oxide of manganese		0.112
Peroxide of iron		1.143
Alumina		3.018
Phosphoric acid		0.111
Sulphuric acid		0.067
Water and organic matter		2.772
Total		99.936
Hygroscopic moisture absorbed at		2.558 23° C.

This, considering the large proportion of insoluble matter, is a fairly good soil, though it is deficient in lime and magnesia. It resembles in composition many of the soils of Florida.

In places, especially along the drainage slopes of the Alabama and Chattahoochee rivers, the red loam occurs as substratum to the soils and subsoils, and frequently, by denudation, comes to form the surface. In this way

quite a variety of soils is produced, but they do not differ from similar soils of the brown-loam uplands, which result from the same admixtures. Occasionally the underlying limestone in its disintegration is mingled with the surface loam, and there results then a red limy soil of great fertility, similar to that of the red-lime lands of Jackson county, Florida. The best known tract of this kind of soil occurs along the Chipola river in Florida, and its northern extremity reaches up into the eastern part of Geneva and adjoining part of Henry county, Alabama. Of a similar nature are the red limy soils of the lowlands of Murder and Bottle creeks, in Conecuh county, which have been spoken of before in connection with the lime-hills region, to which they are contiguous.

The bottom lands of this region have, as a rule, light sandy but productive soils, which vary in quality with those of the uplands adjoining. The usual growth in the bottom lands consists of magnolia, bay, ti-ti, sweet-leaf, juniper, star anise, laurel, sweet shrub, etc.

THE PINE FLATS.

Toward the Gulf coast the rolling pine lands sink away into low pine barrens, in which the tree-growth consists of the long-leaf pine and the so-called Cuban pine, and with these a smaller growth of several species of ilex, etc. The low, wet margins of ponds support a varied and beautiful herbaceous growth, consisting of *Sarracenias*, *droseras*, *Catesby's lily*, and a number of others mentioned in the list of plants. The soil here is sandy and sour, little suited to cultivation, and cotton is not planted. The settlements are mostly confined to the vicinity of the streams.

The coast plain and the islands off the coast have generally a soil of drifting sands, destitute of timber, but supporting a few characteristic shrubs and lesser plants. The pine flats are limited to the lower parts of Mobile and Baldwin counties as a body, but low pine barrens of very similar nature are seen further inland. The area is put at 1,120 square miles.

ALLUVIAL REGION.

This includes the alluvial region of Mobile river and the saline marshes of the coast, and embraces parts of Washington, Mobile, and Baldwin counties, comprising an area of some 130 square miles.

ALLUVIUM OF MOBILE RIVER.

Below the junction of the Alabama and Tombigbee rivers the waters of these streams reach the bay of Mobile by several channels, the principal of which is the Mobile river, but the Tensas and Middle rivers and others diverge from the main stream, and form a kind of delta region, low, flat, and subject to overflow, generally covered with a growth of cypress. Near the bay this swamp assumes the character rather of a marsh, in which the courses of the streams are often nearly indistinguishable. These swamps are uncultivated, and have in the drier spots, besides the cypress, tupelo gum and several species of poplar, elms, palmetto, etc.

SALINE MARSHES OF THE COAST.

These are only found in the counties of Mobile and Baldwin. They are without timber, but have a herbaceous growth chiefly of rushes and sedges, which is characteristic. These plants are enumerated in the list referred to. The muck of decayed vegetable matter from the marshes may often be applied with profit to the sandy soils which adjoin them, and the marshes themselves in other states have sometimes been reclaimed for cultivation. The area of sea-marsh in Alabama, on account of comparatively limited extent of coast, is necessarily small, and few, if any, attempts have been made toward reclamation.

LIST OF TREES AND PLANTS CHARACTERISTIC OF EACH REGION OF THE STATE.

The following is a list, with botanical and common names, of some of the most important and characteristic trees and lesser plants of the various agricultural regions of the state, prepared by Dr. Charles Mohr, of Mobile:

I. *Lower pine region, or coast pine belt*, including—

a. The maritime plain, with saline marshes and flats, and dunes of drifting sands on the islands near the coast and on the sea-shore: Shrubs and trees—*Quercus virens* (live oak), var. *maritima*, and *Q. Phellos* (willow oak), var. *arenaria*, *Quercus virens* being the typical form on the inlets and bayous with higher banks and a more retentive soil; *Vitis incisa*, *Baccharis halimifolia*, *Lycium Carolinianum*, *Yucca aloifolia*. Herbs—*Chenopodium Boscianum*, *Chenopodina maritima*, *Salsola Kali*, *Sesuvium portulacastrum*, *Batatas maritima*, *Ipomœa Pes-Caprœ*, *Cyperus Le Contei*, *Uniola paniculata*, *Panicum repens*. In the saline or brackish marshes: *Baccharis halimifolia*, *Myrica cerifera* (candleberry), *Fimbristylis spadicea*, var. *castanea*; *Juncus Rœmerianus*, *Triglochin triandrum*, *Scirpus maritimus* (rush), *S. pungens*, *Brizopyrum spicatum*, *Statice Caroliniana*, *Gerardia maritima*, *Borrichia frutescens*, *Ipomœa sagittifolia*, *Batis maritima*, *Salicornia ambigua* (samphire), *Cakile æqualis*.

b. Open, grassy river swamps and wooded alluvial bottoms, more or less inundated: Open river swamps—*Zizania aquatica* (wild rice), *Scirpus lacustris* (round rush), *Phragmites communis* (reed), *Panicum virgatum*. Sedges—*Rhynchospora*, several species; *Cladium*, *Carex riparia*, *Cyperus stenolepis*, *C. Michauxianus*, *C. articulatus*, *C. haspan*, *C. virens*, several species of *Sagittaria* (arrowhead), *Cicuta maculata* (water hemlock), *Cacalia lanceolata*, *Gerardia purpurea*, var. *fasciculata*; *Aster flexuosus*, *A. divaricatus*, *Solidago sempervirens* (golden rod), *S. lanceolata*, *Hibiscus Moscheutos*, *Kosteletzkya Virginica*, *Lythrum lineare*. Shrubs—*Persea Caroliniana*, var. *palustris* (red bay); *Myrica cerifera*, *Salix nigra*, *Baccharis halimifolia*. Trees (forest swamps)—*Taxodium distichum*, the variety yielding the red cypress lumber; *Nyssa uniflora*, or tupelo gum; *Populus heterophylla*, *P. monilifera* (cottonwood), *Fraxinus viridis* (ash), *F. platycarpa*, *Persea palustris*, *Carya aquatica* (hickory), *Quercus aquatica* (water oak), *Ulmus alata* (wahoo), *U. Americana* (elm), *Catalpa bignonioides*, *Sabal Adansonii* (dwarf palmetto), *Ilex opaca* (holly), *I. decidua*.

c. Low flat pine barrens, or pine meadows: *Pinus Cubensis* (*P. Elliottii*, pine pitch), *P. australis* (long-leaf pine), *Ilex glabra* (gallberry), *I. Cassine* (yaupon), *Sarracenia* (pitcher-plants) of several species, *Drosera filiformis*, *D. brevifolia* (sundews), *Dichromena leucocephala* (white star-grass), *Eriocaulon*, several species (pipeworts), *Lachnanthes tinctoria*, *Aletris aurea* and *A. farinosa*, *Sabbatia gracilis* and *S. gentianoides* (American centaury), *Tofieldia pubens*, *Lilium Catesbœi*, *Zygadenus glaberrimus*, *Rhynchospora* in numerous species, largely prevailing with *Scleria oligantha*, *S. Elliottii*, and *S. Michauxii*; *Aristida spicata*, *Ctenium Americanum*, *Paspalum racemulosum* and *P. purpurascens*, *Panicum verrucosum*, *P. microcarpon*, and *P. ignoratum*; *Andropogon tener*, *A. Virginicus*, *A. macrourus*, and *A. scoparius* (broom-sedge); *Erianthus alopecuroides*, *Gratiola pilosa*, *Pinguicula lutea*, *Chaptalia tomentosa*, *Bartonia verna*, *Leptopoda fimbriata* and *L. brevifolia*, *Helianthus heterophyllus*, *Bigelovia nudata*, *Erigeron vernum*, several species of *Eupatorium*, *Aster dumosus*, *Liatris odoratissima* (vanilla plant), *L. graminifolia*, and *L. spicata*; *Carphepherus Pseudo-Liatris*, several species of *Ludwigia*, *Polygala ramosa*, *P. cymosa*, *P. cruciata*, *P. Chapmanii*, and *P. Hookerii*; *Linum rigidum*, *Hibiscus aculeatus*, *Hypericum cistifolium*, *H. myrtifolium*, and *H. fasciculatum*.

d. The evergreen glades of the hummock lands and wooded bottoms, more or less sphagnous, with the open swamp bordering upon them: Trees and shrubs—*Magnolia grandiflora* (bull bay), *M. glauca* (bay), *Persea Caroliniana* and its variety *palustris*, *Nyssa Caroliniana*, *Cliftonia ligustrina* (the ti-ti), *Olea Americana*, *Symplocos tinctoria* (sweet-leaf), *Calycanthus lævigatus* (sweet shrub), *Myrica inodora*, *Cupressus thyoides*, or juniper, *Pinus Elliottii*, *P. Tæda* (loblolly pine), *Quercus aquatica* (water oak), *Oxydendrum arboreum*, or sourwood, *Zanthoxylum Clava-Herculis* (prickly ash), *Illicium Floridanum* (star anise), *Ilex coriacea*, *I. Cassine* (yaupon), *I. ambigua*, *I. Dahoon*, *Rhus venenata* (poison elder), *Vaccinium virgatum* and *V. myrsinites* (huckleberries), *Halesia diptera* (snow-drop tree), *Cyrilla racemiflora*, *Bumelia lanuginosa*. In the open swamps: *Sarracenia rubra*, *S. flava*, *S. Drummondii*, *S. Psittacina* (pitcher-plants), *Sabbatia macrophylla*, *Asclepias paupercula* (marsh milkweed), *Tiedemannia teretifolia*, *Lophiola aurea*, *Calopogon pulchellus*, *Pogonia* (several species), *Xyris*, and most of the plants mentioned above as inhabiting the bogs of the pine meadows; *Rhynchospora* (several species), *Paspalum præcox*, *Panicum gibbum*, *Curtisii*, *virgatum*, and *P. proliferum*, *Rottbœllia rugosa*. As taking possession of the waste lands, or the cultivated soils, the following are to be mentioned: *Cyperus rotundus* (nut-grass), *C. repens*, *C. Baldwinii*, *Panicum sanguinale*, or crab-grass, *Cynodon Dactylon* (Bermuda grass), several troublesome bind-weeds, such as *Ipomœa commutata* and *I. lacunosa* (morning-glory), *Sesbania macrocarpa* and *vesicaria*.

e. The rolling pine lands, covered with forests of *Pinus australis*, and almost devoid of undergrowth: *Quercus cinerea* (narrow-leaf black-jack or high-ground willow oak), *Q. nigra* (broad-leaf black-jack, or simply black-jack), *Q. Catesbœi* (forked-leaf black-jack, turkey oak), *Carya tomentosa* (mockernut hickory), *Ceratiola ericoides*, *Sabal serrulata* (saw palmetto), *Asimina parviflora* (dwarf papaw), *Yucca filamentosa* (bear-grass), several species of *Rhynchospora* preferring a sandy, dry soil, such as *R. Grayii*, *R. compressa*, etc. Of grasses: *Danthonia sericea*, *Aristida lanata*, *Sporobolus junceus*, *Eatonia filiformis*, *Paspalum racemulosum*, *P. Floridanum*, *Panicum rufum*, *P. depauperatum*, and *P. dichotomum*, in varieties; *Andropogon Elliottii* and *A. scoparius* (broom-sedge), *Sorghum nutans*, *Brevoria*

humistrata, *Rhynchosia tomentosa* in all its varieties, *R. galactioides*, *Lupinus diffusus* and *L. villosus*, *Galactia sessiflora*, *Rhexia glabella* (deer-tongue), *Chrysobalanus oblongifolius*, *Apium divaricatum*, *Tetragonotheca helianthoides*, *Vernonia angustifolia* (iron-weed), *Sericocarpus tortifolius*, *Liatris elegans*, *L. squarrosa* (rattlesnakes' master), *Helianthus radula*, *Coreopsis senifolia*, *Aster adnatus* and *A. patens*, *Gaillardia lanceolata*, *Eupatorium aromaticum*, *Asclepias Michauxii* and *A. amplexicaulis* (milkweeds), *Sabbatia brachiata* (centaury), *Gerardia Plukenetii*, *G. Skinneriana*, *Ruellia ciliosa*, *Kalmia hirsuta*, *Buchnera elongata*.

Among the weeds of the fields and gardens are prominent *Richardsonia scabra*, or Mexican or Florida clover, crab-grass, *Cassia nictitans*, *Polypremum procumbens*, *Ambrosia artemisiæfolia* (hogweed), and *Erigeron Philadelphicum* (rag-weed).

II. *Region of mixed tree growth, or upper pine region*, including—

a. The lowland, with its heavily-wooded river valleys and creek bottoms. Predominating trees: *Pinus australis*, *P. glabra* (spruce pine), *P. Tæda*, *Cupressus thyoides* (white cedar), *Quercus Michauxii*, Nutt. (swamp chestnut-oak, *Q. Prinus bicolor* of Michx.), *Q. lyrata* (overcup oak), *Q. alba* (white oak), *Q. falcata* (Spanish oak), *Q. rubra* (red oak), *Q. aquatica* (water oak), *Carya alba* (shell-bark hickory), *C. tomentosa* (mockernut), *C. aquatica* (water bitter-nut), *C. porcina* (pig-nut), *Celtis Mississippiensis* (hackberry), *Planera aquatica*, *Platanus occidentalis* (sycamore), *Ulmus Americana* and *U. alata*, *Persea Caroliniana*, *Fraxinus Americana* (white ash), *Acer rubrum* (red or swamp maple), *Negundo acroides* (ash-leaf maple), *Prunus Americana* (red plum), *Tilia Americana* (basswood, linden), *Liquidambar styraciflua* (sweet gum), *Gleditschia triacanthus* (honey-locust), *Ilex opaca* (holly), *Magnolia grandiflora*, *M. acuminata*, *M. macrophylla* (large-leaf bay), *M. Fraseri* (umbrella trees, cucumber trees), *Bumelia lycioides*, *Rhamnus Caroliniana* (buckthorn), *Cratægus spathulata*, *C. apiifolia*, and *C. aestivalis* (haws), *Illicium Floridanum* (star anise), and *Catalpa bignonioides*.

b. Uplands and so-called wooded prairies or post-oak flatwoods: *Quercus tinctoria* (black oak), *Q. obtusiloba* (post oak), *Q. nigra* (black-jack), *Q. falcata* (Spanish oak), *Q. rubra* (red oak), *Carya tomentosa*, *C. amara* (bitternut), *C. porcina*, *Ostrya Virginica* (hop hornbeam), *Castanea pumila* (chincapin), *Æsculus parviflora* (buckeye), *Thalictrum anemenoides*, var. *debile*, *Hepatica triloba* (liver-leaf), *Ranunculus abortivus*, *Zanthorhiza apiifolia* (yellow root), *Calycocarpum Lyonii*, *Viola pedata*, var. *bicolor*, *Hypericum galioides* (in swamps), *Stellaria pubera*, *Silene Virginica*, *Sida Elliottii*, *Habenaria tridentata*, *Geranium maculatum*, *Hydrangea arborescens*, *H. quercifolia* (seven bark), *Philadelphus grandiflorus*, *Stokesia cyanea*, *Callirrhoë Papaver*, *Calamintha Caroliniana*, *Onosmodium Virginianum* and *O. Carolinianum*, *Phacelia pusilla*, *Phlox paniculata*, *Sabbattia chloroides*, *Acerates paniculata*, *Aristolochia tomentosa* (tobacco-pipe), and *Gonolobus hirsutus*. Many of the grasses which are common in the region below occur also here: *Uniola latifolia*, *Bromus ciliatus*, *Arrhenatherum avenaceum*, *Poa flexuosa*. As weeds, besides those above mentioned, the following are common: *Xanthium strumarium* (cocklebur), *Bidens bipinnata* (Spanish needles), *Polygonum*, several species (smartweed), all growing in low rich spots; *Amarantus chlorostachys*, *A. hybridus*, and *A. spinosus* (careless weeds), *Portulaca oleracea* (purslane), *Lepidium Virginicum* (pepper cress), *Specularia perfoliata*, several species of *Cerastium* and *Stellaria* (chickweeds), *Maruta Cotula* (dog fennel), *Helenium augustifolium* (bitter-weed), and several species of *Rubus* (blackberry or bramble).

III. *The Cretaceous plain*, with the so-called bald and wooded prairies of the black belt.

The growth is mostly the same as that of the division adjoining it below. *Quercus Phellos* is here found more frequently and in its best development.

This region is bounded on the north by the interior long-leaf pine region of the central drift belt. Many of the trees and shrubs, such as *Illicium Floridanum* and *Magnolia grandiflora*, occur here, finding their northern limit. The flora of the prairies is similar to that of the grassy plains of the northwestern states east of the Mississippi, with coarse *Silphium*, or rosin-weed (*S. laciniatum* and *S. lævigatum*), *Rudbeckia triloba*, late *Helianthi* (sunflowers), such as *H. atrorubens*, *H. mollis*, *H. tomentosus*, with others; *Lepachis pinnata*, *Petalostemon candidum*, and *P. carneum*; *Schrankia uncinnata*, *Desmanthus brachylobus*, in swamps; *Brunnichia cirrhosa*, *Hibiscus incanus*, *Cacalia ovata*, in copses and wooded banks; *Pycnanthemum linifolium*, *Penstemon digitalis*. Of shrubs, *Prunus umbellata*. Among the grasses *Paspalum distichum* and the crab-grass (*Panicum sanguinale*) are troublesome weeds in the cotton-fields of the black lands; also the various species of *Cassia—occidentalis*, *obtusifolia*, and *Marilandica*.

IV.—*The Mountain region of northern Alabama* to the valley of the Tennessee river, including the oak forests of the metamorphic region. In these *Quercus rubra*, *Q. tinctoria*, and *Q. falcata* greatly predominate.

On the high lands or extensive table-lands of the Carboniferous sandstone the following trees are found: *Pinus australis* (in patches), *P. mitis* (short-leaf pine), *P. Tæda* (loblolly pine), *P. inops* (here called mountain pine), *Quercus coccinea* (scarlet oak), *Q. Prinus* (the mountain or tan-bark oak), *Q. Muhlenbergii*, *Q. nigra*, *Q. rubra*, *Q. obtusiloba*, with *Castanea vesca*, var. *Americana* (the chestnut), more or less stunted hickories and poplars, and the very common *Oxydendrum arboreum*. *Azalea nudiflora* in several forms, *Magnolia acuminata* and *M. cordata*, the butternut (*Juglans cinerea*), *Magnolia umbrella*, and *M. macrophylla* take to the richer slopes and valleys, along with *Tilia heterophylla* and *T. Americana* (the basswoods or lindens), *Ulmus fulva* (slippery elm), poplar (*Liriodendron*), black walnut (*Juglans nigra*), and *Ilex mollis*.

Herbs and shrubs: *Delphinium azureum* and *D. uncinnatum*, *Sanguinaria Canadensis* (blood-root), *Dentaria* (several species), *Thalictrum dioicum*, *T. clavatum*, *Viola blanda*, *V. canina*, var. *sylvestris*, *V. pubescens*, *Hypericum*

aureum, *Arenaria patula*, *Silene regia*, *Polygala Boykinii*, *Rosa lucida* (wild rose), *Pyrus coronaria* (crab-apple), *Calycanthus floridus* (sweet shrub), *Neviusia Alabamensis*, *Croton Alabamensis*, *Sedum Nevii*, *S. pulchellum*, *Heuchera Americana* (alum-root), *Saxifraga Virginiensis*, *Tiarella cordifolia*, *Hydrangea radiata*, *Sericocarpus conizoides*, *Aster Shortii*, *Solidago Curtisii* and *S. amplexicaulis*, *Silphium compositum*, *Parthenium integrifolium*, *Rudbeckia mollis*, *Phacelia bipinnatifida*, *Phlox divaricata*, *Silene rotundifolia*, and *Campanula divaricata*.

Upon the limestone belts of the valleys and the slopes bordering on them are found groves of red cedar (*Juniperus Virginiana*), and on deep rich soils large poplars (*Liriodendron*), black walnut, ash, and white oaks. In the basin of the Tennessee river are found, of forest trees, all those of a more northern range mentioned before, together with shrubs or small trees like the *Æsculus glabra* and *flava*, *Fraxinus quadrangulata*, *Rhus cotinoides*, and *Forestiera acuminata*. Black walnut, poplars, white hickory, and white ash are most frequent.

REMARKS ON COTTON PRODUCTION IN ALABAMA.

[The weight of the bale, as used in this report and in the tables, is 475 pounds, and in all the discussions and comparisons the proportion of lint or fiber to seed-cotton is assumed to be as 1 to 3.]

In total production in the United States Alabama stands No. 4, being below Mississippi, Georgia, and Texas; and in product per square mile Alabama also occupies the fourth place, producing 13.6 bales to the square mile, below Mississippi with 20.5 bales, South Carolina with 17, and Georgia with 13.8.

Some of the most prominent facts connected with the production of cotton in Alabama are set forth in the results of the enumeration presented in tabular form below. From these tables certain inferences may be drawn which are of interest, as showing where the cotton is produced, by whom, and what effect the continuous cultivation of cotton has upon the fertility of the soil.

TABLE III.—SHOWING POPULATION AND COTTON PRODUCTION IN EACH AGRICULTURAL REGION OF THE STATE.

Agricultural regions.	Area in square miles.	POPULATION.			COTTON PRODUCTION.										
							Average per acre.				Total in tons.		Percentage of state's total production.	Cotton acreage per square mile.	Bales per square mile.
		Total.	White.	Colored.	Acres.	Bales.	Fraction of bale (475 pounds).	Seed-cotton.	Lint.	Seed.	Lint.	Seed.			
Total	51,540	1,262,505	662,185	600,320	2,330,086	699,654	0.30	429	143	286	166,168	332,336	100	45	14
Metamorphic region	4,460	129,705	85,072	44,633	236,745	71,285	0.30	429	143	286	16,930	33,860	10	53	16
Coosa valley region	3,930	109,155	78,178	30,977	131,505	52,699	0.40	570	190	380	12,516	25,032	8	33	13
Coal Measures region	5,070	85,928	77,032	8,956	62,863	21,692	0.35	498	166	332	5,152	10,304	3	12	4
Tennessee valley region	5,760	168,502	107,157	61,345	260,861	84,447	0.32	456	152	304	20,056	40,112	12	45	15
Oak and hickory uplands, with short-leaf pine	3,060	53,120	36,813	16,307	87,496	28,806	0.33	471	157	314	6,841	13,682	4	29	9
Gravelly hills, with long-leaf pine	3,990	75,847	42,898	32,949	122,587	37,229	0.30	429	143	286	8,842	17,684	5	31	9
Central prairie region	9,220	376,061	87,877	288,184	1,014,606	278,508	0.27	384	128	256	66,146	132,292	40	110	30
Oak and hickory uplands, with long-leaf pine	9,470	186,633	99,371	87,262	399,357	120,739	0.30	429	143	286	28,676	57,352	17	42	13
Long-leaf pine region	6,580	77,494	47,787	29,707	14,066	4,249	0.30	429	143	286	1,009	2,018	1	2	1

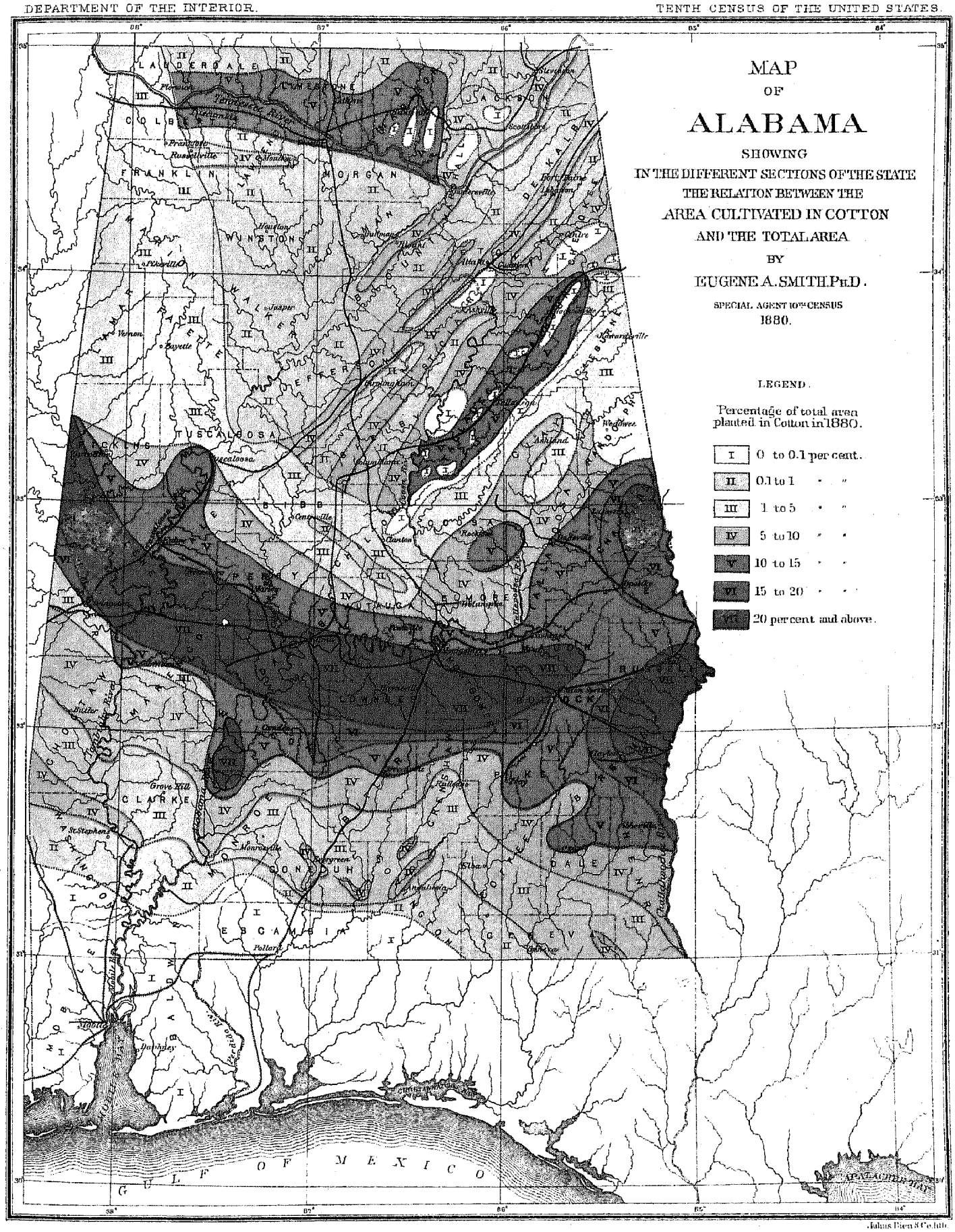
TABLE IV.—SHOWING "BANNER" COUNTIES AS REGARDS TOTAL PRODUCTION AND PRODUCT PER ACRE IN THE VARIOUS AGRICULTURAL REGIONS OF THE STATE.

Regions according to product per acre.	Average product per acre, fraction of a bale (475 pounds).	COUNTY IN EACH REGION HAVING HIGHEST TOTAL PRODUCTION.						COUNTY IN EACH REGION HAVING HIGHEST PRODUCT PER ACRE.					
		Name.	Rank in product per acre in the state.	Cotton acreage.	Total production in bales.	Product per acre, fraction of bale.	Rank in total production in the state.	Name.	Rank in total production in the state.	Cotton acreage.	Total production in bales.	Product per acre, fraction of bale.	Rank in product per acre in the state.
Coosa valley region	0.401	Talladega	11	32,841	11,832	0.360	24	Cherokee	28	24,388	10,777	0.442	2
Coal Measures region	0.345	Marshall	27	16,412	5,358	0.326	44	De Kalb	56	7,469	2,859	0.383	7
Oak and hickory uplands, with short-leaf pine.	0.320	Pickens	26	52,651	17,283	0.328	14	Fayette	52	12,331	4,268	0.346	10
Tennessee valley region	0.324	Madison	47	72,338	20,679	0.284	10	Limestone	16	44,334	15,724	*0.355	14
Gravelly hills, with long-leaf pine	0.304	Tuscaloosa	24	33,773	11,137	0.330	25	Tuscaloosa	25	33,773	11,137	0.330	24
Oak and hickory uplands, with long-leaf pine.	0.302	Wilcox	18	77,076	26,745	0.347	4	Wilcox	4	77,076	26,745	0.347	18
Long-leaf pine region	0.302	Washington	8	3,280	1,246	0.380	59	Baldwin	62	1,384	638	0.461	1
Metamorphic region	0.301	Chambers	54	70,934	19,476	0.275	11	Cleburne	54	9,156	3,600	0.393	6
Central prairie region	0.274	Dallas	45	115,631	33,534	0.290	1	Lowndes	3	98,200	29,356	0.299	41

* Colbert has the same product per acre as Limestone.

BANNER COUNTIES OF THE STATE.—As regards total production—Dallas, 33,534 bales; as regards product per acre (omitting those whose product is less than 100 bales)—Baldwin, 0.461 bale; as regards percentage of tilled land in cotton—Russell, 61 per cent.; as regards cotton acreage per square mile—Montgomery, 152 acres; as regards bales per square mile—Montgomery, 43 bales.

DEPARTMENT OF THE INTERIOR. TENTH CENSUS OF THE UNITED STATES.



AREAS OF GREATEST PRODUCTION.—A statistical map accompanies this report which shows in each region the percentage of the total area planted in cotton; and since the differences in product per acre in the several agricultural regions are comparatively slight, this map shows also approximately the percentage of the whole crop produced in each region.

Upon examination of this map, or of the statistical tables given on page 60, we see that the central prairie region produces 40 per cent. of the entire cotton crop of the state, the oak, hickory, and long-leaf pine region 17 per cent., the Tennessee valley 12 per cent., the metamorphic 10 per cent., the Coosa valley 8 per cent., the gravelly hills 5 per cent., the short-leaf pine uplands 4 per cent., the Coal-measures region 3 per cent., and the long-leaf pine region less than 1 per cent. But these relations will be much more clearly shown if we take into consideration also the relative areas of these regions and rate them according to the number of bales to the square mile. The several regions will then rank as follows:

	Bales to the square mile.
1. Central prairie region	30
2. Metamorphic region	16
3. Tennessee valley region	15
4. Coosa valley region	13
5. Oak, hickory, and long-leaf pine region	13
6. Oak, hickory, and short-leaf pine region	9
7. Gravelly hills	9
8. Coal Measures	4
9. Long-leaf pine region	1

By this arrangement we are able to recognize three well-defined areas of large production in the state. These are: 1, the central cotton belt; 2, the Tennessee valley; 3, the Coosa valley. The first of these areas produces at least 60 per cent. of the cotton crop; the second, 12 per cent.; the third, 8 per cent.; while the remaining 20 per cent. is produced by the rest of the state.

The nucleus of the central cotton belt is composed of the 12 counties of the prairie region, together with Chambers and Lee counties and the southern portion of Tallapoosa county, of the metamorphic region. On each side of this nucleus there is a margin consisting of the adjacent portions of the counties of the short-leaf pine uplands and gravelly hills on the north, and of the oak, hickory, and long-leaf pine uplands on the south, in which the cotton production assumes nearly as great proportions as in the prairie belt itself. In this way are included the southern parts of Pickens, Tuscaloosa, Autauga, and Elmore counties, and the northern parts of Wilcox, Butler, Crenshaw, Pike, and Henry counties.

The width of this central cotton belt across the state is not much less than 75 miles, and the cotton production throughout the area thus defined is 20 bales and upward to the square mile.

Of the counties which form the nucleus of the central cotton belt Dallas has the largest total production, because of its greater area; but if we take into account the differences of area, Montgomery occupies the first place, producing 43 bales to the square mile. After Montgomery come Lowndes with 40 bales, Dallas and Bullock with 34 each, Chambers with 32, and so on down the list, ending with Tallapoosa, which has 17 bales to the square mile. It will be seen by reference to the tables that some of the marginal counties of this central belt show a yield for the whole county of 20 bales and upward to the square mile, which would, of course, bring up the yield of the portion of the county actually embraced in the central region.

The second well-marked area of large production is found in the Tennessee valley, with its greatest intensity along the immediate valley of the river, and the relative importance of the several counties here included in the production of cotton may be approximately measured by the relative proportion of the red or valley lands in the area of each. Applying the test of area devoted to cotton, we find that the counties rank as follows: Madison, Limestone, Lawrence, Lauderdale, Colbert, Jackson, Morgan, and Franklin; but in eliminating the disturbing influence of difference in area, and taking account also of the product per acre, their rank as regards the number of bales to the square mile becomes: Limestone, Madison, Lawrence, Colbert, Lauderdale, Morgan, Jackson, and Franklin. Of these counties only the first two produce over 20 bales to the square mile.

The third large cotton-producing area is the Coosa valley. In actual production to the square mile this falls behind the other two regions, being 13 bales, while that of the Tennessee valley is 15, and that of the central cotton belt 20 bales and upward. Both in total production and in cotton acreage, and especially in the number of bales to the acre, the counties of this region fall behind those of the two preceding. Talladega county stands first, with 17 bales to the square mile; then come Calhoun, Cherokee, Etowah, Saint Clair, and lastly Shelby, with 9 bales.

We have thus seen where the great proportion of the cotton crop of Alabama, 80 per cent., is produced. As regards the rest of the state not much more need be said, except concerning the Coal Measures and the long-leaf pine regions, which show a production of 4 bales and 1 bale respectively to the square mile. With regard to the former region, it is to be remarked that the greater part of the cotton is produced in the valleys which traverse it, and not upon the soils of the true Coal Measures. Winston and Cullman may be taken as fair representatives of this region.

POPULATION AND COTTON PRODUCTION.—Taking the state as a whole, the cotton production of Alabama is 0.55 bale to the inhabitant, or little more than a bale for every two inhabitants. This proportion varies in the

different agricultural regions. In the Tennessee valley and the gravelly pine hills the proportion is exactly a bale to two inhabitants; in the short-leaf pine uplands the proportion is a little more than a bale to two inhabitants, and in the Coosa valley it is slightly less. In the central prairie region the proportion is a bale and a half, and in the oak, hickory, and long-leaf pine uplands a bale and a quarter to every two inhabitants. In the last-named region, however, there are parts of some of the counties immediately adjoining the prairie region in which the same proportion probably obtains as in the prairie region itself. The same is true of the counties of Chambers and Lee; so that for the great central cotton belt the proportion is about three-fourths of a bale to the inhabitant.

Following out these relations a step further, we find that over 55 per cent. of the colored population of the entire state is to be found in the central cotton belt, where about 60 per cent. of the cotton is produced. Something over 10 per cent. of the blacks are found in the second cotton area, the Tennessee valley, and about 5 per cent. in the Coosa valley. This accounts for more than 70 per cent. of the colored population, which is thus concentrated in the three large cotton-producing areas of the state, where about 80 per cent. of the cotton crop is produced.

The distribution of the whites in the same regions is as follows: In the central cotton belt, about 18 per cent; in the Tennessee valley, about 16 per cent.; and in the Coosa valley, about 12 per cent.; thus accounting for about 46 per cent. of the white population, as inhabiting the three large cotton-producing areas, against 70 per cent. of the blacks in the same areas. The other regions of the state which produce the remaining 20 per cent. of the cotton support 54 per cent. of the white population, but less than 30 per cent. of the blacks. Since the proportion of the white to the black population in the whole state is about 1.1 to 1, or not far from equal, it seems to follow that the greater part of the cotton crop of Alabama is produced by the negroes.

PRODUCT PER ACRE AND ITS RELATION TO POPULATION.—In product per acre Alabama stands No. 13 of the fourteen principal cotton-producing states of the Union. Other things being equal, the product or yield per acre may be taken as an index to the fertility of a soil, and if we apply this test to the several agricultural regions of Alabama they take the following rank:

1, Coosa valley; 2, Coal Measures; 3, oak, hickory, and short-leaf pine uplands; 4, Tennessee valley; 5, gravelly hills; 6, oak, hickory, and long-leaf pine uplands; 7, long-leaf pine region; 8, metamorphic; and 9, central prairie region.

Putting Chambers and Lee together with the counties which constitute the *prairie region*, we have the nucleus of the central cotton belt as above defined. In all these counties the average product per acre is 0.27 of a bale. This somewhat unexpected result cannot be considered as due to the relative infertility of the soils of this belt, for correspondents unite in giving as the average yield on the fresh lands of this region from 700 to 1,600 pounds of seed-cotton, or from one-half a bale to more than a bale to the acre, and the chemical analyses show that these soils in their virgin state are among the very best in the state. We are led, therefore, to the conclusion that the soils of the great cotton belt have been exhausted by improvident culture, and, as a matter of fact, we know that in many parts of this belt cotton is planted year after year upon the same soils without rotation with other crops, and without an attempt at maintaining the fertility by the use of manures. In the other parts of the state where cotton is produced a selection is generally made of the better soils, rotation of crops is more generally practiced, and in some sections fertilizers are in more general use.

That the character of the laborers and the system of farming practiced are largely concerned in determining the yield cannot, on general principles, be denied, and we find ample proof that these two things are responsible in no small degree for the results above shown.

The *central cotton belt* is generally a region of large farms or plantations, in which the laborers are chiefly negroes, as seen in the tables. As a rule, these laborers do not own the land, have no interest in it beyond getting a crop from a portion of it, which they rent either for a sum of money or for a share of the crop, and are not interested in keeping up the fertility, at least not to the extent of being led to make any attempts at the permanent improvement of the same. In the case of the owner of the land, while the conditions are different, the result is the same. He is, of course, interested in the improvement of his land; but to supply the fertilizers for a large plantation, when he cultivates it by hired labor, would cost more than he usually has to expend, and where the share system, or that of renting, prevails he is still further removed from personal care of the land; and thus from all causes there is an exhaustive cultivation of the land, without any attempt at maintenance or restoration of its lost fertility.

In addition to these, the system of advances or credit, so prevalent throughout the cotton-producing parts of the state, is not without its evil influence, for the laborer, and too often the owner of the land, is obliged to get advances of provisions from their merchants, for the payment of which the crop is mortgaged; and as cotton is the only crop which will always bring ready money, its planting is usually insisted on by the merchants making the advances and selected by the farmer as a means of providing for payment. In this way cotton comes to be the paramount crop, and there is little chance for rotation with other things.

In this connection it will be instructive to read the reports given under Part III, treating of cultural details. It will there be seen that the system of credits in the large cotton-producing regions prevails to such an extent that the whole cotton crop is usually mortgaged before it is gathered; and when we consider that the prices charged for provisions, etc., thus advanced are at least 50 per cent. higher than regular market rates, and that the cost of

producing cotton is given by our correspondents, almost without exception, at 8 cents a pound, it will need very little calculation to show that the laborer who makes a profit of only 2 or 3 cents a pound or $12 to $15 a bale on his cotton will have the chances too greatly against him ever to be out of debt to his merchants when he relies solely upon this crop to provide the money; and the exorbitant interest on the money advanced is not likely to be lessened so long as the merchants' risks continue to be as great as they are.

In the *Tennessee and Coosa valleys*, which are also large cotton-producing sections, a similar state of things may be observed. In Madison and Talladega counties the blacks outnumber the whites, and in both we find the product per acre falling far below the average of the region in which they are situated. Thus Madison shows a product of 0.28 bale, against the average of 0.32 for the whole Tennessee valley, and Talladega a product of only 0.36 bale, when the average for the Coosa valley region, of which it is a part, is 0.40. Wherever the black population is in excess of the white we may take it for granted that the system of large farms rented out to the negroes prevails, and the inevitable result of this system of farming thus becomes apparent in these sections also.

In the other agricultural regions of the state, and in most of the counties also of the Tennessee and Coosa valleys, the farms are, as a rule, small, and are cultivated by their owners, with the assistance of such labor as may be hired from time to time. In all these cases provisions are produced on the farm, and cotton is planted as a secondary crop. There is thus some chance for selection of the soils and for rotation of crops; and when a man cultivates his own farm fertilizers are in more general use, so that even with soils naturally much inferior to those of the main cotton-producing regions the average product per acre is much higher in these regions of small production.

In the *Coal-Measures* region, which takes rank as third in product per acre, there are no large farms, and the whites outnumber the blacks nearly 9 to 1 (a sure sign of poor soil), the farmers generally owning the land which they cultivate.

Until very recently only the lands of the valleys traversing the Coal Measures have been planted in cotton, so that the product per acre as given in the tables is an index rather of the fertility and capabilities, under proper culture, of the calcareous valley soils than of those directly derived from the rocks of the Coal Measures. In Winston and Cullman there are no valley soils, hence the product per acre of these counties may be taken as representing that of the soils of the Coal Measures generally, viz, 0.26 to 0.28. In these regions it is usual to plant only the better kinds of soils in cotton, and of late only with the application of some kinds of commercial fertilizers. These sandy lands, which have a clayey substratum, are more and more every year, with moderate quantities of fertilizers, coming into use in the production of cotton, and the same may also be said of the siliceous portions of the valley lands of the regions just spoken of. It is now thought to be pretty well established that these poorer sandy lands, with the aid of moderate quantities of fertilizers, make in the long run better-paying and more certain crops of cotton than the intrinsically better classes of soils without the fertilizers.

In the *short-leaf pine upland* counties the whites are more than twice as numerous as the blacks. The same conditions, therefore, hold here as in the case just mentioned. The product per acre is 0.33 per bale.

The soils of the *gravelly hills* are practically the same as those of the short-leaf pine lands, but the product is 0.30 bale to the acre, and that of the oak, hickory, and long-leaf pine uplands about 0.30, with likewise very similar soils. In these the two races are present in nearly equal proportions. These figures furnish an additional illustration of what has been shown above, viz, that the greater the proportion of blacks among the population the more prevalent will be the system of large farms worked on shares or by renting and the smaller will be the yield of the land so cultivated, because of the inherent vices of the system.

The concentration of the black population in the great farming regions of the state, which are also the regions of the originally most fertile soils, is amply shown by Table III; and so closely does this class of the population follow the best lands that the density of the colored population of any region might almost be taken as an index of the fertility of its soils. The white population is much more evenly distributed over good and poor lands alike, so that the proportion between the two races varies with the fertility of the soils. (*a*)

If we examine any county whose product per acre falls below the average of the region of which it forms a part, we shall find almost without exception that this is due either to the improvident culture which invariably attends the system of large farms (and the prevalence of this system is almost invariably shown by the preponderance of negroes among the population) or to the comparative infertility of the soil, as may be inferred from the preponderance of the whites. Thus in the county of Marion, in the short-leaf pine uplands, we find the product only 0.31, and we see that the county is inhabited almost entirely by white men. Again, in Pickens, there is a slight falling below the average, and here we find one-third more negroes than whites (large farms and bad culture).

In the *gravelly hills region* Autauga falls below the average, notwithstanding it possesses some of the best second-bottom lands of the Alabama river. In this county the negroes outnumber the whites two to one.

a The negroes were originally brought together upon these great cotton-producing areas as the slaves of the wealthy planters who bought up the greater part of the best lands in the state. Since the war they have remained, practically speaking, in the same places where as laborers in the cotton-field (with which they were most familiar) they could always be sure of employment and of a good living without too severe labor. The social attractions also of these great centers of negro population have not been without their influence in keeping the race together.

In the *oak, hickory, and long-leaf pine region* we meet with some exceptions to the general rule. Most of these, however, admit of explanation. Thus, Choctaw follows the rule: excess of blacks, below the average of product per acre. Clarke, Monroe, and Wilcox form exceptions: large negro population and high product per acre. This finds its explanation in the fact that the cotton lands of those three counties are either the very best of river lands, such as form Black's bend, in Wilcox, or the equally fertile lime-hills or black-shell prairie lands, like those in the vicinity of Limestone and Flat creeks, in Monroe. Butler and Pike follow the rule: excess of white population, small farms, better cultivation, general use of fertilizers, all of which combine to bring up the product per acre above the average for the region. The lower counties, such as Conecuh, Coffee, Dale, and Henry, lie within the limits of the long-leaf pine region, where the poverty of the soil is more than an offset to the better cultivation practiced on small farms. Conecuh has also a large negro population on some of its best lime-lands to keep down the average product.

In the counties of the *open piny woods* there is comparatively little cotton produced, not much more than 1,000 bales in any of the counties. There is thus a selection of the best lands for the planting of cotton, and a correspondingly high yield in Baldwin, Washington, and Escambia, with the additional circumstance that in Washington there are fine lime-hills and shell prairies, with the highly productive river bottoms, which lie adjacent to the same, to bring up its average.

Covington and Geneva, in their very small percentage of blacks (only one in seven or eight), show that their low product per acre must be due to the original poverty of the soil, and the open piny woods which make so large a proportion of these counties would lead us to expect none but soils of much less than average fertility.

The position of Alabama as a state, next to the lowest in product per acre of the fourteen cotton-producing states, has already been justly explained by Dr. Hilgard as due to the exhaustion of the soils by bad or improvident culture, and to the fact that the system of returns to the soil is not yet in general practice, as is shown by the very limited use made of fertilizers. The conditions of the different regions as above set forth furnish ample illustration of the truth of this conclusion.

INFERENCES TO BE DRAWN FROM THESE COMPARISONS.—To recapitulate, the following conclusions seem, therefore, to be plainly taught by the discussion of the data contained in the tables presented on page 60:

1. That where the blacks are in excess of the whites there are the originally most fertile lands of the state. The natural advantages of the soils are, however, more than counterbalanced by the bad system prevailing in such sections, viz, large farms rented out in patches to laborers who are too poor and too much in debt to merchants to have any interest in keeping up the fertility of the soil, or rather the ability to keep it up, with the natural consequence of its rapid exhaustion and a product per acre on these, the best lands of the state, lower than that which is realized from the very poorest.

2. Where the two races are in nearly equal proportions, or where the whites are in only slight excess over the blacks, as is the case in all the sections where the soils are of average fertility, there is found the system of small farms, worked generally by the owners, a consequently better cultivation, a more general use of commercial fertilizers, a correspondingly high product per acre, and a partial maintenance of the fertility of the soils.

3. Where the whites are greatly in excess of the blacks (three to one and above), the soils are almost certain to be far below the average in fertility, and the product per acre is low from this cause, notwithstanding the redeeming influences of a comparatively rational system of cultivation.

4. The exceptions to these general rules are nearly always due to local causes, which are not far to seek, and which afford generally a satisfactory explanation of the discrepancies.

FERTILIZERS.

THE USE OF FERTILIZERS IN COTTON PLANTING IN ALABAMA.—In the foregoing remarks on cotton culture incidental mention has been made of the use (or, to speak more correctly, of the non-use) of commercial fertilizers, from which it may be inferred that systematic efforts at the maintenance of the fertility of the soils in Alabama are not generally made by the farmers. There is, however, probably not a farm in the state where the barnyard manure and composts produced on the farm are not spread upon the land. This kind of manuring is almost universally practiced, but in this way only a very small proportion of the land receives any assistance. In many sections cotton-seed, either alone or composted with other things, and in certain cases also the cottonseed-meal, are beginning to be somewhat generally used, but always as yet sparingly, and upon a small portion only of the whole area in cultivation. In the regions of small farms, and especially where the soils are originally not very strong, the use of commercial fertilizers, guanos, superphosphates, etc., is gradually extending, and more rapidly in the eastern than in the western half of the state. There are many soils until recently thought to be too unproductive for cotton planting which are now quite extensively used for this purpose, since it has been found that, with the use of small quantities of commercial fertilizers, better returns of cotton are realized from such soils than from better soils without the fertilizers. Instances of this are seen in the gray flinty lands of the Coosa valley, the sandy lands of the Coal Measures, and the Barrens of the Tennessee valley.

In the southern counties of the oak, hickory, and long-leaf pine uplands, and in the long-leaf pine region itself, the poor quality of the soils has compelled the farmers to use some means of bringing up the yield, so that the

cultivation of cotton may be at all profitable, and in the eastern half of this region, south of the main central cotton belt, there is probably more sale of the various brands of commercial fertilizers than in any other part of the state of equal area. A central distributing station for much of this southern country is Troy, in Pike county, and it is a matter of common observation that very few of the wagons which haul the cotton to that market return without a load of guano or some other fertilizer. In the Coosa valley region also these brands of commercial fertilizers are now being generally sold in small quantities to farmers. In the Tennessee valley, except on the poorer soils, such as the Barrens, very little besides stable manure or cotton-seed is as yet used as manure. In the great central cotton belt the same remark will apply, only here the manuring is even less generally practiced than in the Tennessee valley. In no instance, except perhaps in some parts of the southern counties above mentioned, is anything more than a very small proportion of the land thus enriched.

It may be said, in general terms, that in the great cotton-producing areas of Alabama the use of commercial fertilizers in cotton planting is comparatively unknown. In the regions of moderate production the system of returns to the soil is more generally practiced, and the use of commercial fertilizers is gradually extending from east to west, being at its best, however, even in these regions, far short of the universal practice. In the regions of very small production these fertilizers are also very seldom in use, the high yield frequently observed in some sections being generally due to the fact that the best soils only are selected for cotton, or that the patches are small enough to be fertilized by the compost produced upon the farm.

FERTILIZERS NATURALLY OCCURRING IN ALABAMA.—As to the necessity of using some means for maintaining the fertility of soils there can now be no two opinions, and exhaustion is, of course, only a matter of time in the case of any soil which is continuously cultivated without restoring to it in some way a portion at least of the plant-food abstracted by the crops produced upon it. It becomes, therefore, a matter of the greatest importance to know what are the resources of the state for keeping up this fertility.

The two classes of manures generally distinguished are *stimulant* and *nutritive*. To the first class belong those substances which, like lime, serve chiefly to render available the plant-food already present in the soil, but in such a condition as to be not readily assimilated by the growing crop. To the second class belong those mixtures which contain some or all of the elements of plant-food, chief among which are nitrogen, potash, and phosphoric acid.

Stimulant manures.—In nearly all parts of Alabama limestone is easily accessible, from which lime for agricultural purposes may be prepared in sufficient quantity. The use of a merely stimulant manure does not keep up the soil fertility, but on the contrary enables crops to draw heavily upon its reserve of plant food, and thus causes its available portion to be exhausted all the more speedily. Lime is also extensively used to promote the rapid decay of vegetable matter, to convert it into humus, and in this way also it is beneficial to soils. The presence of lime in soils has further the effect of increasing their capacity for resisting drought and improving their tilling qualities generally. In addition to all these, it is directly necessary to the growth of all plants. It is chiefly, however, as a stimulant and as a promoter of the formation of humus from vegetable matter that it finds an extended use in agriculture.

Nutritive manures.—Of the partial manures belonging to this class the most extensively used are the guanos, superphosphates, and ground bones, the principal ingredients furnished by these being potash, phosphoric acid, and ammonia. Cotton-seed or cottonseed-meal is also rapidly coming into use as a fertilizer, and it is one of the best, since it contains all of the essential ingredients of plant-food, and may therefore be considered as more nearly a complete manure than any of the others mentioned. In the marls of the state, however, we have a class of fertilizers which combine the qualities of a stimulant with those of a nutritive manure, and they are therefore worthy of careful attention. These marls are found in the Cretaceous and Tertiary strata of the southern division of the state, and are of several varieties. In all the marls there is a certain proportion of nutritive matter in addition to the lime.

Cretaceous marls.—Materials which might profitably be used as fertilizers occur in all three of the subdivisions of the Cretaceous formation in Alabama.

In the lowermost, or Eutaw group of this formation, the deposits are mostly sandy and clayey and non-calcareous, except in the upper strata, which correspond to the Tombigbee sand of Mississippi.

These beds consist of laminated clays and micaceous sands, the latter often of a greenish color, and contain only a small percentage of lime. A specimen of this material from the Turkey Creek hills, near Pleasant Ridge, in Greene county, has the composition given on page 66.

The rotten limestone is itself in composition a marl containing from 20 to 85 per cent. of carbonate of lime, which is the constituent upon which its chief value as a stimulant manure rests; but in addition to the carbonate of lime this rock contains also a variable percentage of phosphate of lime, ranging, according to Dr. Mallett's analyses, between 0.37 and 0.54 per cent.; of potash, from 0.04 to 0.11 per cent.; and of silica in a condition readily soluble in dilute acids, from 0.06 to 0.19 per cent. Several analyses of the rotten limestone from different parts of the state are to be found in Professor Tuomey's second report.

Some of the strata of the rotten limestone contain notable quantities of greensand, and well deserve the attention of farmers. According to Dr. Loughridge, there is a bed of Cretaceous greensand marl extending along the Chattahoochee river bluff for 15 miles with an average thickness of 10 or 15 feet. It contains about 2 per cent. of potash, and would undoubtedly be valuable to the farmers in reach of it.

Near Epes station, in Sumter county, there is another greensand marl bed, and a sample was analyzed with the result given below.

No. 132. *Greenish sand*, Pleasant Ridge, Greene county. This consists of grains of quartz sand, often coated with a green material, scales of mica, rounded and flattened lumps of greensand, and fragments of lignite. The greensand makes only a small proportion of the whole mass, and the marl would hardly pay for the hauling; but its effects upon the soils, over which it is distributed by natural causes, are seen in the luxurious vegetation of the lands which receive the washings of these hills. In other localities it is quite probable that a richer material may be found.

No. 145. *Greensand marl* (Cretaceous), Epes, Sumter county.

Greenish sand and greensand marl (Cretaceous).

	GREENE COUNTY.	SUMTER COUNTY.
	Greenish sand.	Greensand marl.
	No. 132.	No. 145.
Insoluble matter	76.734 } 77.896	57.617 } 59.395
Soluble silica	1.162 }	1.778 }
Potash	0.398	1.489
Soda	0.115	0.118
Lime	0.899	8.922
Magnesia	0.592	0.193
Brown oxide of manganese	0.170	0.101
Peroxide of iron	8.457	13.988
Alumina	0.091	2.161
Phosphoric acid	0.051	0.143
Sulphuric acid	0.789	0.160
Carbonic acid	.....	10.628
Water and organic matter	10.216	2.260
Total	99.674	99.508

The marl, while it contains less lime than the ordinary rotten limestone, is likely to prove valuable as a fertilizer because of its high percentage of potash.

Dr. Mallet tested a sample of greensand from near Gainesville, and found in it: Potash, 2.437 per cent.; phosphoric acid, 0.183 per cent.; and carbonate of lime, 0.87 per cent.

The upper or Ripley group of the Cretaceous is in part composed of bluish micaceous marls containing greensand. In the region of their occurrence these marls give rise to lasting and productive soils, well known in the low grounds of Cowikee and Bear creeks in Barbour and Russell counties.

Dr. Mallet has made several partial analyses of this class of marls, of which the following, a bluish or greenish-gray marl, containing grains of sand, particles of mica, and fragments of shell, from below Eufaula, may be taken as a representative:

	Marl.	Limestone.
Carbonate of lime	13.47	88.82
Carbonate of magnesia	1.01	2.18
Peroxide of iron	3.21	.....
Alumina	1.08	0.94
Phosphoric acid	0.18	0.23
Silicic acid (soluble in acid)	0.54	.....
Insoluble matter (finely divided clay, sand, and specks of mica)	79.14	7.20
	98.03	99.37

In the same formation there are beds of hard and tolerably pure limestone, which might be used in the preparation of lime for agricultural purposes. One of the samples analyzed by Dr. Mallet (see above) from Chunnenugga ridge, Macon county, was a highly fossiliferous limestone, the shells for the most part white crystalline carbonate of lime, and the limestone cementing them together of a light brownish-gray color, containing numerous small cavities, often lined with carbonate of lime. This is the character of much of the limestone of the Chunnenugga ridge.

Tertiary marls.—A special examination was made by me, for the purposes of this report, of the marls and other mineral fertilizers of the Tertiary formations of Alabama. These materials may be conveniently arranged in two classes, viz: I, the greensands, and, II, the calcareous marls; and the latter into those which contain greensand and those whose value depends chiefly upon their content of lime.

I. *The greensands.*—The lower 300 or 400 feet of the Tertiary formation in Alabama are made up, in the main, of sands and clays of lignitic character, but interstratified with these, at several horizons, are beds of marine origin. One of the lowermost of these marine deposits may be seen outcropping at Nanafalia landing, on the Tombigbee river, and may be traced across the country to the Alabama river at Coal bluff, and thence eastward through part of Wilcox county, and perhaps further. One of the strata of this group consists of a mixture of quartz grains, small rounded or flattened lumps of greensand, and a few small particles of mica. The thickness of the deposit is only a foot or two; the color, deep yellowish-green. This greensand bed is best exposed where the Linden and Nanafalia road crosses Double creek in Marengo county. The analysis on page 69 shows the composition of a sample (No. 128) selected from this locality.

Apparently the same bed is exposed on Gravel creek near Camden, Wilcox county, two specimens of which were partially analyzed by Dr. Mallett, yielding in 100 parts:

	No. 1.	No. 2.
	Per cent.	*Per cent.*
Potash	2.21	1.89
Lime	0.69	0.67
Phosphoric acid	Trace.	Trace.
Iron pyrites	Trace.	None.

II. *Calcareous marls: Greensand marls.*—Associated with the bed of greensand above described are several calcareous beds which also hold notable quantities of the same mineral. At Nanafalia landing the upper part of the bluff is formed of 6 feet or more of a shell bed very rich in greensand, which is overlaid by a stratum from 8 to 10 feet thick, composed almost entirely of the shells of a small oyster (*Gryphæa Thyrsa*).

The greensand bed is a mixture of grains of quartz sand, small rounded lumps of greensand, and fragments of shells, together with a large number of perfect and unbroken shells. A sample selected for analysis (No. 127) has the composition given on page 69.

These calcareous beds may be traced across Marengo county by the prairie soils to which they give rise, and are exposed again at Coal bluff, on the Alabama river. A sample from this locality, partially analyzed by Dr. Mallett, consisted of greensand grains, siliceous clay, fine quartz sand, fragments of shells, etc., and had the following composition:

	Per cent.
Potash	1.67
Phosphoric acid	1.00
Carbonate of lime	29.33
Iron pyrites	10.57

Dr. Mallett analyzed also some of the separate grains of greensand of this deposit, the mean of two analyses of which was—

	Per cent.
Silica	57.56
Alumina	6.56
Ferrous oxide	20.13
Lime	1.04
Magnesia	1.70
Potash	4.88
Water	8.17
Total	100.04

The value of marls of this kind depends not only on the carbonate of lime which they contain, but also upon the potash of the greensand, and are therefore the more valuable in proportion to their percentages of greensand, and this proportion may be approximately estimated by the color, the deeper the green the better.

There can hardly be a doubt that these beds will some day be utilized, as they contain a higher average of potash than any of the Tertiary greensand marls thus far examined.

The most convenient localities for getting at the marl for shipment are the Nanafalia landing, on the Tombigbee, and Coal bluff, on the Alabama river. At Turner's ferry, on the Tombigbee, above Tuscahoma, there is exposed a second-marine deposit, containing shells and greensand, but no special examination has been made of it.

Farther down the river, in the vicinity of Wood's bluff, a third exposure of these marine deposits is seen. The marl beds at this place are about 25 feet in thickness, and their geological position is some 175 or 200 feet below the series of aluminous sandstones and claystones to which the name buhrstone has been applied. The strata intervening between the buhrstone rocks and the top of the marl bed are laminated lignitic clays and sands, with a few thin seams of lignite; below the marl, again lignitic beds.

The marl at Wood's bluff is not of uniform composition, the lower strata being much richer both in calcareous matter and in greensand. The upper part of the marl is commonly indurated, forming a kind of limestone, below which the soft pulverulent marl is sometimes sheltered and sometimes washed out, leaving overhanging ledges and caves. This bed, with practically identical features, has been traced from the vicinity of Butler, in Choctaw county, through Choctaw Corner, in Clarke county, to the Alabama river below Lower Peach Tree. The beds occurring at Elba, in Coffee county, are probably the same also, though their identity has not been perfectly established.

Two samples of this marl were analyzed, the one from Mr. Hendrick's, near Butler, the same bed appearing in very many localities about that town, the other from the "Natural Bridge", a few miles west of Choctaw Corner. The specimens analyzed consist of a mixture of broken-up shells, quartz sand, and grains of greensand. In this matrix are imbedded many beautifully preserved entire shells.

No. 126. *Greensand shell marl* from Hendrick's, near Butler, Choctaw county.

No. 130. *Greensand shell marl* from the "Natural Bridge", 2 miles west of Choctaw Corner, Clarke county.

These, like all the greensand marls, owe their peculiar value to the greensand which they contain; hence the more pronounced the green color the better the marl. The 25 to 30 per cent. of carbonate of lime which they all hold is also, of course, of value.

Where these marl beds outcrop across the country they react upon the laminated lignitic clays with which they are interbedded, giving rise to a series of lime-hills of considerable fertility. For an analysis of this class of soil consult lime-hills soil, No. 140, Wilcox county (page 42).

The fourth outcropping of a marl bed down the river from Wood's bluff is seen at Coffeeville landing and vicinity. From its geographical position this seems to be geologically above the buhr-stone rocks, and consists of several beds, chiefly fossiliferous clayey sands and pulverulent and indurated marls.

A sample (No. 138) taken from a loose pulverulent bed just below a hard ledge of similar composition is composed of quartz sand, comminuted shells, a small proportion of greensand grains, and an occasional particle of mica. Its composition is given in the table on page 69. Like the others, this marl, aside from its carbonate of lime, owes its value to its content of greensand.

The lower portion of the bluff at Claiborne, on the Alabama river, consists of sandy, argillaceous, and calcareous beds, the latter containing many oyster shells. A sample from one of these beds, about 15 feet above the water level (No. 136), was composed of quartz grains, pulverulent carbonate of lime, clayey matter, and a few grains of greensand. Its chemical composition is given on page 69. From the similarity in the fossils (which have not, however, been very closely studied) it appears probable that the Coffeeville marl bed is identical with some of the lower strata of the Claiborne bluff.

Ordinary calcareous marls, white marls.—At the Claiborne bluff the stratum, 15 to 20 feet in thickness, which has furnished all the beautifully preserved fossils which have made this locality so celebrated is a mass of comminuted shells and quartz sands stained with iron. In this material the Claiborne fossils are imbedded. A sample of this marl from Mrs. Gibson's, a short distance below Claiborne, was analyzed. Its composition is given on page 69 under No. 135, Claiborne shell marl from Mrs. Gibson's, near Claiborne. The value of this marl rests mainly upon its carbonate of lime. With from 47 to 50 per cent. of inert siliceous matter, it would hardly be profitable to carry it far, but it might be used with advantage in the vicinity.

This shell stratum is one of the topmost of the Claiborne group proper. Immediately above it are laminated gray clays and fossiliferous yellowish sands containing greensand, and above these a thick bed of whitish, soft limestone, containing occasionally a few grains of greensand. This limestone is considered as belonging to the Jackson group of the Tertiary, and in its disintegration gives rise to the prairie soils of the lower lime-hills region, and is in many respects similar to the Cretaceous rotten limestone. Its composition may be seen from the subjoined analysis of soft, white limestone (No. 137) overlying the shell stratum at Claiborne (Jackson age).

This, like the rotten limestone, is itself of the nature of a marl, and its action upon the soil is well shown in the prairie soils of the lime-hills.

In very many of the localities where this limestone occurs crystals and large masses of gypsum are imbedded in the clays which result from its disintegration, and sometimes in such quantity that it might be profitably taken up for agricultural purposes. Nothing has, however, yet been done in this direction. The unusually high percentage of sulphuric acid in the limestone, as well as in many of its derived soils, is probably due to the gypsum.

The uppermost division of the Tertiary in Alabama, the so-called Vicksburg group, is made up chiefly of white or light-colored limestones and marls, the most common rock being a soft, white limestone, containing orbitoides and other characteristic fossils. A sample of this rock from Clarke county, above Jackson (No. 146), has been analyzed, and its composition is given in the table relative to Tertiary marls.

This, as will be seen, is a tolerably pure limestone, and when burned would give a large yield of lime. Its potash and phosphoric acid also are rather above the average.

To recapitulate: The mineral fertilizers of the Alabama Tertiary formations are greensands, greensand marls, and white marls and limestones, which occur at the following horizons, viz:

1. Greensand and greensand marls at Nanafalia landing and across the country to Coal bluff, on the Alabama river, and on Gravel creek, in Wilcox county. These beds appear to be the richest in greensand.

2. A marl bed at Turner's ferry, above Tuscahoma, on the Tombigbee.

3. The greensand marls at Wood's bluff; found also near Butler, in Choctaw county, and across Clarke county, to the Alabama river, below Lower Peach Tree.

4. Greensand marls at Coffeeville and at Claiborne, and, at the latter place, also near the top of the bluff, the shell marl.

5. Overlying the Claiborne shell beds, the marly or argillaceous limestone of Jackson age, which is known by its outcrops and by the peculiar soils resulting from it, from the western limit of the state, through Washington and Clarke, into Monroe and Conecuh, and thence in detached tracts to southeastern Alabama.

6. The white marls and limestones of the Vicksburg group, occurring in all the localities mentioned in the preceding paragraph, but much more widely distributed.

Most of the localities above given are in western Alabama. The Tertiary formations in the eastern part of the state are more generally calcareous and less intermingled with lignitic strata than is the case westward, and they appear also to be more generally hidden by the superficial drift deposits.

Marls and limestones are exposed on the Chattahoochee river at intervals from below Eufaula down to the Florida line, but I am at present unable to give any details concerning them.

Analyses of Tertiary marls.

	GREENSAND.	GREENSAND SHELL MARLS.					ORDINARY MARLS.		
	MARENGO COUNTY.	MARENGO COUNTY.	CHOCTAW COUNTY.	CLARKE COUNTY.		MONROE COUNTY.	MONROE COUNTY.	CLEBURNE COUNTY.	CLARKE COUNTY.
	Greensand.	Greensand shell marl.	Hendrick's, near Butler.	Near Choctaw Corner.	Greensand shell marl.	Marl, with greensand.	Claiborne shell marl.	Soft, white limestone.	White lime stone.
	No. 128.	No. 127.	No. 126.	No. 130.	No. 138.	No. 136.	No. 135.	No. 137.	No. 146.
Insoluble matter	78.712	35.918	65.005	62.329	63.153	60.434	45.877	28.394	2.542
Soluble silica	1.195 } 79.907	1.363 } 37.281	2.833 } 67.838	2.115 } 64.444	1.153 } 64.306	1.876 } 62.310	1.981 } 47.858	2.920 } 31.314	
Potash	0.635	2.254	1.026	0.457	0.372	0.633	0.331	0.502	0.347
Soda	0.087	0.340	0.085	0.252	0.259	0.222	0.498	0.077	0.132
Lime	0.859	24.164	13.757	16.866	14.491	15.390	26.514	34.952	47.779
Magnesia	0.284	1.617	0.616	0.705	0.594	0.856	0.065	0.743	0.602
Brown oxide of manganese	0.011	0.079	0.029	Trace.	0.089	0.321	Trace.	0.156	0.653
Peroxide of iron	9.102	12.324	4.286	2.083	2.149	3.867	2.332	1.798 }	3.123
Alumina	1.103	0.930	0.083	0.139	1.883	1.355	0.769	1.159 }	
Phosphoric acid	0.086	0.041	0.161	0.223	0.040	0.125	0.029	0.096	0.305
Sulphuric acid	0.051	0.310	0.106	0.054	0.164	0.117	0.070	0.290	0.623
Carbonic acid	Traces.	18.986	10.983	14.154	12.359	11.805	20.552	27.471	39.000
Water and organic matter	5.713	0.726	1.393	1.366	3.102	2.832	1.554	2.207	4.162
Total	97.928	99.060	100.363	100.743	99.808	99.833	100.572	100.765	99.268

Of other naturally occurring materials which have been profitably used, either in compost heaps or directly upon the lands, there may be mentioned pond or marsh muck, which is specially rich in humus and also in certain mineral elements of plant-food. This substance is generally accessible in the state, and should, whenever practicable, be used in connection with the marls mentioned.

Professor Hilgard long since called attention to the value of the straw of the long-leaf pine as a manure, and his analyses show that it contains in considerable quantities the mineral ingredients necessary to plants. According to the same authority, the best manner of applying it, next to incorporating it with the manure pile, is to compost the manure with lime or some of the calcareous marls of which mention has been made, and, after it has become thoroughly decayed, then to spread it upon the land.

The following analysis of a specimen of muck from a swamp near the banks of Autauga creek, at Prattville, Autauga county, will show the general nature of this material. The swamp has a dense growth of magnolia, bay, laurel, short-leaf pine, sweet gum, sassafras, maple, elder, button-ball, white oak, swamp oak, dogwood, buckeye, *Rhus vernix*, etc. When cleared and drained such swamps are at first liable to suffer the drawbacks incident to an excess of humus, but after being a while in cultivation, and sand and loam become mixed with the humus, very productive soils result.

No. 2. *Black swamp muck* from the bottom of Autauga creek, at Prattville, Autauga county. A light-black pulverulent mass when dry.

Swamp muck, Autauga county.

	No. 2.
Insoluble matter	51.678
Soluble silica	
Potash	0.487
Soda	0.265
Lime	0.472
Magnesia	0.007
Brown oxide of manganese	Trace.
Peroxide of iron	Trace.
Alumina	1.362
Phosphoric acid	0.060
Sulphuric acid	0.296
Water and organic matter	44.574
Total	99.201
Hygroscopic moisture	18.47
absorbed at	20.5 C.°

The hygroscopic character of the humus is here well exhibited. The material contains a comparatively large percentage of lime and potash, but the phosphoric acid is rather deficient. This muck would improve the physical characters both of light sandy and of heavy clayey soils.

Table of analyses of Alabama soils and subsoils.

Number.	Name.	Locality.	County.	Depth in inches.	Vegetation.	Insoluble residue.	Soluble silica.	Potash.	Soda.	Lime.	Magnesia.	Brown oxide of manganese.	Ferric oxide.	Alumina.	Phosphoric acid.	Sulphuric acid.	Carbonic acid.	Volatile matter.	Total.	Hygroscopic moisture.	Temperature of absorption (C.°).	Analyst.
	METAMORPHIC REGION.																					
78	Red lands soil	6 miles north of Opelika.	Lee	10	Red, Spanish, and post oaks, and some short-leaf pine.	68.710	3.830	0.350	0.119	0.043	0.050	0.100	10.740	9.237	0.170	0.080	.....	7.011	100.440	7.396	27.8	John B. Durrett.
79	Gray lands soils	....do	....do	8	....do	79.170	3.256	0.268	0.067	0.167	0.130	0.093	3.144	5.120	0.229	0.043	.....	7.742	99.429	4.535	26.7	Do.
107	Mica slate soil (graphitic).	4 miles north of Roanoke.	Randolph	8	Post, black, red, and black-jack oaks; some pine and hickory.	77.354	3.936	0.536	0.086	0.010	0.145	0.146	6.861	5.693	0.067	0.057	.....	4.772	99.713	4.612	7.2	Henry McCalley.
103	Mica slate soil (garnetiferous).	S. 27, T. 19, R. 7 E.	Clay	4	Black, post, red, and Spanish oaks; a few chestnuts.	66.174	9.263	0.351	0.246	0.038	0.155	0.151	9.303	8.086	0.137	0.090	.....	5.706	99.697	5.910	6.1	Do.
	COOSA VALLEY REGION.																					
70	Flatwoods soil	3 miles northeast of Ashville.	Saint Clair	10	Post oaks, short-leaf pine, and hickory.	70.650	8.933	0.277	0.078	0.159	0.478	0.079	6.528	7.497	0.075	0.013	.....	4.777	99.544	11.150	27.2	Chappell Cory.
71	Red valley soil	1½ miles south of Jacksonville.	Calhoun	12	Red, Spanish, and post oaks, hickory, and short-leaf pine.	80.520	3.941	0.290	0.062	0.112	0.260	0.057	5.011	5.722	0.126	0.056	.....	4.501	100.658	8.063	26.7	John B. Durrett.
76	....do	Near Mrs. Walker Reynolds.	Talladega	12	Red, white, Spanish, and post oaks, sweet and sour gums, and hickory.	64.070	7.647	0.339	0.111	0.091	0.143	0.137	7.157	11.229	0.176	0.010	.....	*8.298	99.408	19.400	24.4	Do.
45½	Red upland soil	Near Pratt's ferry	Bibb	6–12	White, black, and post oaks, walnut, hickory, chestnut, mulberry, cedar, dogwood, and black gum.	81.480	6.530	0.328	0.027	0.255	0.210	0.189	2.016	5.074	0.110	0.167	.....	3.587	100.513	4.528	28.3	Chappell Cory.
67	Little Cahaba valley soil.	6 miles southwest of Springville.	Saint Clair	12	Red, black, and Spanish oaks, hickory, chestnut, and sweet gum.	73.433	7.459	0.240	0.041	0.225	0.476	0.241	5.518	7.498	0.165	0.007	.....	4.719	100.022	9.525	7.2	Henry McCalley.
69	Gray upland cherty soil.	1 mile north of Ashville.	....do	10	Red and Spanish oaks, liriodendron, hickory, dogwood, and short-leaf pine.	83.440	4.230	0.109	0.018	0.202	0.181	0.042	2.178	4.521	0.093	0.048	.....	5.301	100.363	8.528	26.7	Chappell Cory.
123	Sandy brown-loam soil	3 miles west of Birmingham.	Jefferson	10	Red and willow oaks, sassafras, and grape-vines.	25.990	4.341	0.176	0.028	0.152	0.116	0.041	2.840	3.188	0.066	0.051	.....	2.522	99.511	7.835	24.4	Henry McCalley.
68	Red mountain soil	3 miles north of Springville.	Saint Clair	10	Large liriodendron, white oak, and chestnut.	81.560	3.680	0.206	0.037	0.363	0.279	0.214	4.918	3.539	0.168	0.083	.....	4.830	99.877	9.799	27.2	Chappell Cory.
111	Red lands soil	Dry valley n'r Gaylesville.	Cherokee	8	Red, post, white, and Spanish oaks, hickory, persimmon, chestnut, black gum, sourwood, and dogwood.	78.725	6.042	0.261	0.124	0.330	0.395	0.215	3.707	5.077	0.089	0.097	.....	*5.150	100.212	4.500	26.7	John B. Durrett.
	COAL-MEASURES REGION.																					
110	Upland soil	Sand mountain near Valley Head.	DeKalb	10–20	Chiefly red oak, some black oak, hickory, dogwood, and chestnut.	86.350	4.352	0.230	0.141	0.068	0.154	0.070	1.443	6.324	0.073	0.062	.....	0.842	100.111	3.368	16.1	Henry McCalley.
	TENNESSEE VALLEY REGION.																					
40	Barrens soil	Near Cluttsville	Madison	8	Post, black, red, Spanish, and black-jack oaks, scrub hickory, wild gooseberry, blackberry, and huckleberry.	89.950	2.292	0.255	0.064	0.064	0.035	0.150	1.695	3.292	0.100	0.178	.....	2.024	100.099	4.450	21.1	John B. Durrett.
48	....do	Near Huntsville	....do	6	Scrubby post and black oaks, dogwood, and some hickory.	84.160	4.560	0.116	0.025	0.041	0.159	0.041	2.705	4.597	0.054	0.045	.....	3.388	99.891	4.785	28.3	Chappell Cory.
52	Gravelly soil	Limestone creek bottom.	....do	.....	Poplar, beech, sugar maple, sycamore, gum, walnut, red, white, and black oaks.	79.005	6.023	0.270	0.161	0.182	0.224	0.239	2.871	4.834	0.200	0.010	.....	*5.758	99.786	6.881	9.4	Henry McCalley.
56	Gravelly river hills soil.	Tennessee river near Tuscumbia.	Colbert	4½	Red, white, and black-jack oaks, dogwood, white poplar, and scrub walnut.	79.320	6.760	0.309	0.067	0.398	0.226	0.324	2.969	4.771	0.153	0.172	.....	4.458	99.927	5.371	28.3	Chappell Cory.
38	Red lands soil	Near Cluttsville	Madison	11	Hickory, poplar, ash, chestnut, walnut, black, red, and white oaks, elm, cedar, black haw, and dogwood.	77.950	5.343	0.243	0.058	0.648	0.058	0.103	2.873	6.198	0.188	0.025	.....	*6.620	100.307	9.760	21.1	John B. Durrett.
34	....do	1 mile east of Tuscumbia.	Colbert	10	Black-jack, post, and red oaks, hickory, and some cedar.	76.023	8.995	0.276	0.133	0.267	0.381	0.218	5.230	5.691	0.151	0.020	.....	*1.794	99.179	8.840	7.8	Henry McCalley.

* See table of humus determinations.

Table of analyses of Alabama soils and subsoils—Continued.

Number.	Name.	Locality.	County.	Depth in inches.	Vegetation.	Insoluble residue.	Soluble silica.	Potash.	Soda.	Lime.	Magnesia.	Brown oxide of manganese.	Ferric oxide.	Alumina.	Phosphoric acid.	Sulphuric acid.	Carbonic acid.	Volatile matter.	Total.	Hygroscopic moisture.	Temperature of absorption (C.°).	Analyst.
	TENNESSEE VALLEY REGION—continued.																					
64	Red lands soil	Near Russellville, in Russell's valley.	Franklin	15	Red, black, white, post, and black-jack oaks, cedar, dogwood, chestnut, black walnut, cherry, and black locust.	75.360	5.237	0.154	0.110	0.250	0.250	0.138	5.623	8.163	0.229	0.039	.....	4.100	99.653	6.140	26.7	John B. Durrett.
36	Sandy loam soil	Little mountain, near Tuscumbia.	Colbert	8	Chestnut, short-leaf pine, hickory, post oak, small sourwood, wild pinks, and phlox.	93.630	1.682	0.100	0.060	0.120	0.040	0.102	0.761	1.532	0.051	0.028	.....	2.055	100.161	1.560	25.6	Do.
	GRAVELLY PINE-HILLS REGION.																					
6	Upland sandy loam	4 miles east of Prattville.	Autauga	8	Short-leaf pine, red and post oaks, hickory, dogwood, black gum, chestnut, persimmon, and mulberry.	89.100	2.840	0.076	0.018	0.060	0.061	0.122	1.577	4.350	0.077	0.034	.....	2.206	100.518	3.882	16.1	Chappell Cory.
57	Brown-loam soil	Near Mulberry	do	.....	White, post, and red oaks, hickory, dogwood, black gum, and some pine.	91.510	1.960	0.115	0.004	0.057	0.140	0.027	1.527	0.943	0.042	0.013	.....	2.888	99.226	2.905	28.3	Do.
60	Brown loam subsoil of No. 57.	do	do	6–12	do	84.520	4.620	0.136	0.010	0.109	0.172	0.071	2.422	6.078	0.078	0.074	.....	2.477	100.767	5.390	28.9	Do.
3	Upland pine woods soil.	Near Prattville	do	8	Long-leaf pine, hickory, red, post, and black-jack oaks; black gum.	94.170	1.300	0.040	0.006	0.069	0.052	0.117	0.744	0.603	0.002	0.009	.....	2.807	100.069	1.916	23.9	Do.
4	Upland pine woods subsoil of No. 3.	do	do	12–18	Dogwood, persimmon, muscadine, buckeye, and sassafras.	88.860	3.380	0.111	0.029	0.047	0.139	0.125	1.572	4.320	0.077	0.002	.....	1.660	100.322	6.079	18.9	Do.
61½	Pond lands soil (exhausted).	Near Mulberry	do	6–12	Sweet gum mostly	78.630	6.045	0.193	0.094	0.019	0.198	0.079	0.810	7.951	0.076	0.132	.....	6.101	100.328	7.697	27.8	Do.
9	Alabama river hummock soil.	4 miles west of Montgomery.	do	8	Red and white oaks, poplar, beech, sweet gum, elm, hickory, cherry, walnut, mulberry, sourwood, dogwood, thorny ash, grapes, and muscadines.	77.080	6.037	0.335	0.189	0.136	0.303	0.384	5.357	4.841	0.137	0.040	.....	*5.230	100.069	8.193	17.2	Henry McCalley.
20	Warrior river hummock soil.	Near Tuscaloosa	Tuscaloosa	6	Dense cane thicket	73.995	6.518	0.252	0.052	0.468	0.429	0.006	4.395	5.182	0.274	0.071	.....	*8.893	100.535	18.811	17.2	R. H. Loughridge.
66	do	do	do	14	Originally cane; now sweet gum and red oak.	69.900	10.987	0.448	0.033	0.343	0.547	0.190	5.303	6.004	0.325	0.072	.....	6.311	100.463	8.707	29.4	Do.
21	Warrior river hummock soil (cultivated 20 years).	do	do	14	Dense cane thicket	73.339	8.777	0.383	0.052	0.314	0.502	0.041	4.590	5.288	0.214	0.072	.....	6.617	100.189	15.836	20.0	Do.
22	Subsoil of Nos. 20, 21, and 66.	do	do	14–24	do	71.227	10.665	0.504	0.196	0.241	0.516	0.081	10.254	2.105	0.284	0.034	.....	4.490	100.597	14.016	16.7	Do.
	OAK, HICKORY, AND LONG-LEAF PINE UPLANDS.																					
140	Lime-hills soil	10 miles west of Lower Peach Tree.	Wilcox	8	Mostly beech, some hickory, short-leaf pine, oaks, ash, poplar, sweet and sour gum, holly, etc.	75.550	1.134	0.174	.....	0.184	0.014	0.032	5.545	7.772	0.229	0.060	.....	8.922	99.616	17.067	10.5	Henry McCalley.
94	Sandy upland soil (cultivated).	Near Clayton	Barbour	1–12	Post oak, black-jack, hickory, dogwood, and short-leaf pine.	95.091	1.913	.....	0.007	0.010	0.056	0.131	0.603	1.386	0.025	0.001	.....	0.443	99.666	0.878	5.6	Do.
84	Upland sandy-loam soil.	Near Lawrenceville	Henry	10	Red, Spanish, and post oaks, black-jack, hickory, chestnut, gum, short-leaf pine, and some long moss.	95.115	1.155	0.212	0.096	0.058	0.030	0.128	0.803	0.703	0.100	0.016	.....	2.009	100.434	1.225	23.3	John B. Durrett.
18	Upland brown-loam soil.	5 miles southeast of Troy.	Pike	8	Red oak; few short-leaf pines	91.965	1.915	0.077	0.013	0.112	0.094	0.044	1.431	1.841	0.109	0.015	.....	2.137	99.753	2.590	19.4	R. H. Loughridge.
19	Upland brown-loam subsoil.	do	do	8–20	do	90.960	2.425	0.150	0.056	0.048	0.080	0.092	1.574	3.197	0.072	0.072	.....	1.532	100.258	2.826	18.3	John B. Durrett.
92	Alabama river second-bottom soil.	Near Lower Peach Tree.	Wilcox	9	Sweet-gum, short-leaf pine, poplar, Spanish, red and white oaks, haw, and hackberry.	86.510	3.269	0.168	0.074	0.221	0.055	0.184	1.783	2.290	0.200	0.073	.....	4.510	99.337	5.916	22.2	Do.

	CENTRAL PRAIRIE REGION.																					
30	Black prairie soil	8 miles northeast of Livingston.	Sumter	10	Post, red, and black-jack oaks, cedar, and prairie white oak.	46.990	17.920	0.444	0.077	1.961	0.603	0.108	6.944	12.418	0.102	0.072	.....	*11.720	99.359	12.330	23.3	Chappell Cory.
32	....do	2 miles north of Livingston.	....do	10	Post, red, and black-jack oaks, cedar, prairie white oak, walnut, and cane.	81.745	2.346	0.205	0.076	0.960	0.061	0.192	3.843	6.168	0.318	0.152	.....	*4.075	100.141	6.042	26.7	John B. Durrett.
16	....do	4 miles from Union Springs.	Bullock	12	Post and black oaks, short-leaf pine, haw, crab-apple, and some red oak.	57.831	10.431	0.288	0.027	0.981	0.802	0.452	7.855	11.488	0.507	0.030	.....	8.036	98.728	14.489	16.7	Henry McCalley.
77	Black prairie slough soil.	8 miles south of Montgomery.	Montgomery.	8	Hickory and white oak chiefly	25.188	23.792	0.441	0.119	8.672	1.170	0.173	7.074	15.565	0.201	0.125	5.728	*11.589	99.843	19.992	7.2	Do.
17	Post-oak prairie soil	Near Union Springs	Bullock	12	Post oak, with long moss, hickory, short-leaf pine, and blackjacks.	71.366	11.981	0.209	0.016	0.371	0.290	0.055	6.983	6.022	0.251	0.073	.....	*2.888	100.505	8.574	16.7	Do.
11	Chunnenugga ridge soil.	....do	....do	6	Chestnut, short-leaf pine, and red oak.	94.770	0.486	0.156	0.069	0.081	0.069	0.156	0.706	0.733	0.101	0.057	.....	2.642	100.026	1.943	18.3	John B. Durrett.
12	Chunnenugga ridge subsoil.	....do	....do	6–20	....do	96.810	1.060	0.165	0.107	0.110	0.035	0.065	0.490	0.867	0.113	0.035	.....	0.550	100.407	0.822	16.7	Do.
13	Upland sandy-loam soil.	2½ miles south of Union Springs.	....do	6	Black and some post oaks, short-leaf pine, and huckleberry.	93.890	1.878	0.209	0.134	0.076	0.021	0.065	0.883	1.260	0.058	0.083	.....	2.062	100.619	1.842	18.9	Henry McCalley.
96	Low grounds soil	Cowikee creek	Barbour	8	Red, white, and post oaks, hickory, and short-leaf pine.	73.303	11.592	0.245	0.060	0.280	0.351	0.113	2.666	5.489	0.113	0.013	.....	4.708	98.933	5.544	5.6	Do.
	FLATWOODS REGION.																					
25	Post-oak flatwoods soil	4 miles west of Livingston.	Sumter	10–48	Post oak chiefly, red oak, hickory, and short-leaf pine.	67.020	10.050	0.295	0.125	0.198	0.610	0.115	6.543	10.198	0.212	0.027	.....	5.031	100.424	13.040	28.3	John B. Durrett.
26	Post-oak flatwoods subsoil.	....do	....do	10–48	....do	79.662	5.031	0.223	0.059	0.359	0.596	0.073	7.711	3.308	0.072	0.026	.....	2.356	99.476	12.841	9.4	Henry McCalley.
98	Post-oak flatwoods clay	6 miles south of Linden	Marengo	10	Post oaks chiefly	72.746	8.926	0.416	0.112	0.080	0.691	0.106	12.406	2.473	0.103	0.061	.....	1.906	100.026	13.941	7.8	Do.
	LIME-HILLS REGION.																					
139	Black-shell prairie soil	R. A. Long, S. 9, T. 8, R. 3 W.	Washington	8	Dogwood, white and black oaks, sweet gum, ash, short-leaf pine, etc.	21.655	1.754	0.553	0.192	29.195	0.489	0.113	5.421	5.155	0.371	0.462	22.177	12.845	100.382	13.560	20.5	Do.
90	Upland brown-loam soil	6 miles north of Gosport.	Clarke	10	Post, red, black, and Spanish oaks, short- and long-leaf pine, and some hickory.	87.753	3.087	0.140	0.010	0.096	0.066	0.050	1.999	3.397	0.120	0.010	.....	3.080	99.808	2.895	23.3	John B. Durrett.
91	Under clay or subsoil of No. 90.	....do	....do	24–36	....do	71.652	5.962	0.350	0.048	0.326	0.091	0.133	7.408	8.606	0.295	0.080	.....	5.187	100.138	14.380	22.2	Do.
89	Murder creek second-bottom soil.	2 miles west of Evergreen.	Conecuh	12	Sweet gum, magnolia, white and water oaks, and short-leaf pine.	89.870	1.592	0.140	0.016	0.094	0.018	0.078	2.385	3.355	0.122	0.005	.....	2.480	100.155	2.653	23.9	Do.
	LONG-LEAF PINE REGION.																					
88	Upland pine-woods soil	13 miles east of Andalusia.	Covington	10	Long-leaf pine, post, Spanish, black-jack, and upland willow oaks, and some hickory.	90.815	1.575	0.170	0.036	0.085	0.032	0.112	1.143	3.018	0.111	0.067	.....	2.772	99.936	2.558	23.3	Do.

* See table of humus determination.

Analyses showing the composition at different depths of the surface beds of loam and drift in the southern division.

115	Brown-loam soil	Near city of Tuscaloosa	Tuscaloosa	5	.....	81.683	0.465	0.255	0.175	0.140	0.097	0.102	4.184	7.081	0.090	0.025	.....	5.425	99.722	6.305	18.0	Daniel W. Langdon, jr.
116	Subsoil of No. 115, deep red.	....do	....do	5–18	.....	84.777	0.656	0.205	0.175	0.065	0.100	0.099	4.903	6.278	0.086	0.083	.....	2.288	99.715	7.275	18.0	Do.
117	Under subsoil of No. 115, deep red.	....do	....do	18–42	.....	91.493	0.066	0.150	0.140	0.071	0.005	0.066	2.495	3.466	0.007	0.071	.....	1.987	100.017	5.647	19.0	Do.
118	Red sandy loam (under No. 117).	....do	....do	42–90	.....	88.989	1.827	0.139	0.135	0.045	0.004	0.061	2.592	3.998	0.007	0.066	.....	1.791	99.654	4.103	18.0	Do.
119	Red sandy loam, becoming yellowish below (under No. 118).	....do	....do	90–114	.....	96.405	0.687	0.005	0.004	0.006	0.002	0.003	1.910	0.786	0.003	0.004	.....	0.841	100.656	3.996	18.0	Do.
120	Yellowish coarse sand (below No. 119).	....do	....do	114–168	.....	98.370	0.086	0.005	0.003	0.004	0.001	0.002	0.717	0.454	0.001	0.004	.....	0.752	100.399	0.290	19.0	Do.
122	Gray clay, specked with red.	....do	....do	Bottom of gully.	.....	81.837	0.256	0.256	0.197	0.341	0.194	0.010	0.576	11.314	0.001	0.150	.....	5.140	100.272	.....	.....	Do.

Table showing humus and available inorganic matter in soils (percentages are referred to soils).

	No. 76.	No. 111.	No. 52.	No. 38.	No. 34.	No. 9.	No. 20.	No. 30.	No. 32.	No. 77.	No. 17.
Humus	0.984	1.365	1.974	2.242	0.700	1.047	2.310	2.830	2.000	2.460	0.718
Available inorganic matter	.....	1.061	0.860	1.551	0.956	0.862	1.255	0.740	1.430	1.874	2.426
Available phosphoric acid	0.020	0.029	0.073	0.109	0.020	0.058	0.112	0.060	0.108	0.037	0.015

Analyses showing composition of greensands, greensand marls, shell marls, and limestones of the Cretaceous and Tertiary formations of Alabama.

Number.	Name.	Locality.	County.	Insoluble residue.	Soluble silica.	Potash.	Soda.	Lime.	Magnesia.	Brown oxide of manganese.	Ferric oxide.	Alumina.	Phosphoric acid.	Sulphuric acid.	Carbonic acid.	Volatile matter.	Total.
132	Greenish micaceous sands (Cretaceous).	Pleasant Ridge	Greene	76.734	1.162	0.398	0.115	0.899	0.592	0.170	8.457	0.091	0.051	0.789	.....	10.216	99.674
145	Greensand marl (Cretaceous).	Epes Station	Sumter	67.617	1.778	1.439	0.118	8.922	0.193	0.101	13.988	2.161	0.143	0.160	10.628	2.260	99.508
128	Greensand (Tertiary).	Double creek	Marengo	78.712	1.195	0.635	0.087	0.859	0.284	0.011	9.192	1.103	0.080	0.051	traces.	5.713	97.928
127	Greensand shell marl (Tertiary).	Nanafalia landing	do	35.918	1.363	2.254	0.346	24.164	1.017	0.079	12.324	0.930	0.041	0.310	18.986	0.728	99.060
126	do	Hendricks, near Butler.	Choctaw	65.005	2.833	1.026	0.085	13.757	0.616	0.029	4.286	0.083	0.161	0.106	10.983	1.393	100.363
130	do	Near Choctaw Corner.	Clarke	62.329	2.115	0.457	0.252	16.866	0.705	trace.	2.083	0.139	0.223	0.054	14.154	1.366	100.743
138	do	Coffeeville landing	do	63.153	1.153	0.372	0.259	14.491	0.594	0.089	2.149	1.383	0.040	0.164	12.359	3.102	99.808
136	Marl, with greensand (Tertiary).	15 feet above water-level at Claiborne.	Monroe	60.434	1.876	0.633	0.222	15.390	0.856	0.321	3.667	1.355	0.125	0.117	11.805	2.832	99.803
135	Claiborne shell stratum (Tertiary).	Mrs. Gibson's, Claiborne.	do	45.877	1.981	0.331	0.498	26.514	0.005	trace.	2.332	0.769	0.029	0.070	20.552	1.554	100.572
137	Soft, white limestone (Tertiary, Jackson).	Overlying shell stratum at Claiborne.	do	28.394	2.920	0.502	0.077	34.952	0.743	0.156	1.798	1.159	0.096	0.290	27.471	2.207	100.765
146	White limestone (Tertiary, Vicksburg).	North of Jackson	Clarke	2.542		0.347	0.132	47.779	0.602	0.653	3.123		0.305	0.623	39.080	4.162	99.268
2	Black swamp muck	Prattville	Autauga	51.678		0.487	0.265	0.472	0.007	trace.	trace.	1.362	0.060	0.296	.....	44.574	*99.001

*Hygroscopic moisture, 18.47; absorbed at 20.5 C.°.

No. 146 was analyzed by T. W. Palmer; all the others by Henry McCalley.